MAR 13 1934

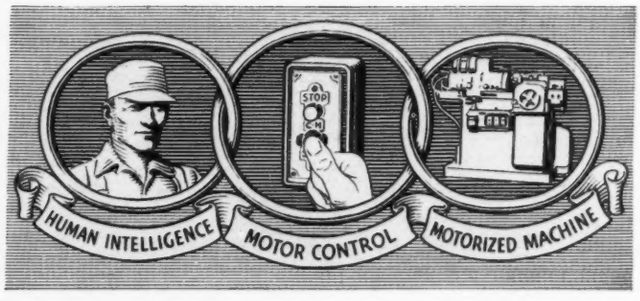
MARCH 1934

MACHINE DESIGN

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

LINKING *the* PEOPLE built a nation



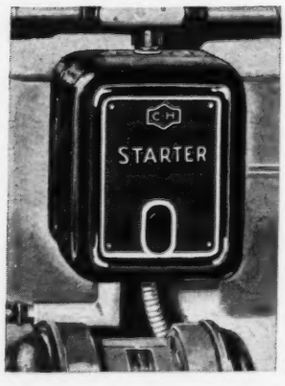
AN idea in a pigeonhole is nothing; properly *transmitted* it can move multitudes to action. This linking of ideas with their users is the essence of progress.

In Industry, Motor Control is the link between human skill and the brute strength of motorized machines.

Being the *vital* link, Motor Control has a bearing on the speed and dependability of production, the quality of workmanship, the cost of power and maintenance, the safety of men, motors and machines throughout industry.

Wise builders of motor-driven machines never lose sight of this important fact. They see Motor Control as much more than a small, low-cost unit in their designs. They recognize Motor Control as the one link between human intelligence and machine performance. They refuse to hazard the consequences of *indifference* toward Motor Control.

Standardize on Cutler-Hammer Motor Control to insure the performance of your machines and to add another sales feature at no expense. You, too, should call in C-H engineers while designs are in the blueprint stage. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1310 St. Paul Ave., Milwaukee, Wisc.



The designing and building of Motor Control is a separate and distinct division of electrical engineering. The place to go for consultation and advice on Motor Control problems is to a control specialist. Cutler-Hammer indisputably qualifies as such a specialist. Your problems will be welcomed here. A letterhead request brings the C-H Catalog.

CUTLER HAMMER

The Control Equipment Good Electric Motors Deserve

NRA (B-210)

MACHINE DESIGN

FRANKLIN H. JOHNSON
Publisher

VOLUME VI MARCH, 1934 NUMBER 3

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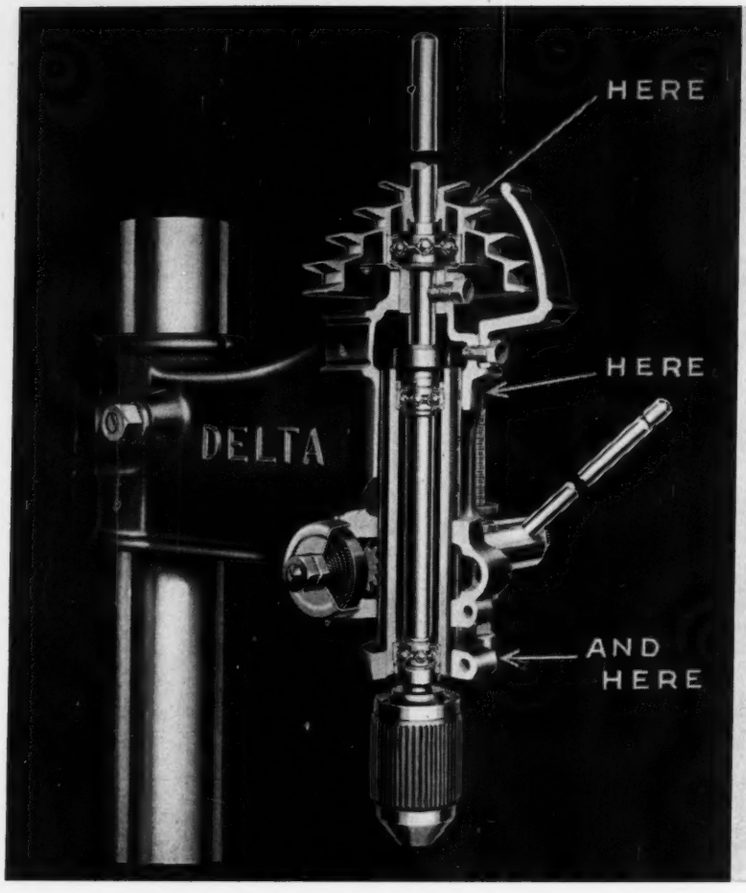

ADVANCED BEARING PRACTICE in Delta tools

ENGINEERS of the Delta Manufacturing Co., of Milwaukee, Wisconsin, have undoubtedly started something in drilling machine construction. They employ self-lubricated, double N–D–Seal, New Departure Ball Bearings. To users, this means perfect sealing and ideal lubrication . . . sealing that prevents lubricant leakage and entry of dirt. » » » Here is what Mr. H. E. Tautz, President of Delta, has to say: "We have had unusually good success with your double-seal bearings in high speed vertical spindles. Our experience has been that whenever a ball bearing fails (which is not often), ninety-nine times out of one hundred it is because dirt entered the bearing, or lubricant leaked out and was replaced with a brand unsuitable for ball bearings. That is why we have chosen double-seal bearings." » » » Write for literature and data on N–D–Seal Ball Bearings. » » » The New Departure Mfg. Company, Bristol, Connecticut.

NEW DEPARTURE
BALL BEARINGS

2079

ITEMIZED INDEX

Classified for Convenience when Studying Specific Design Problems

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Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Oxwelding helps « « «

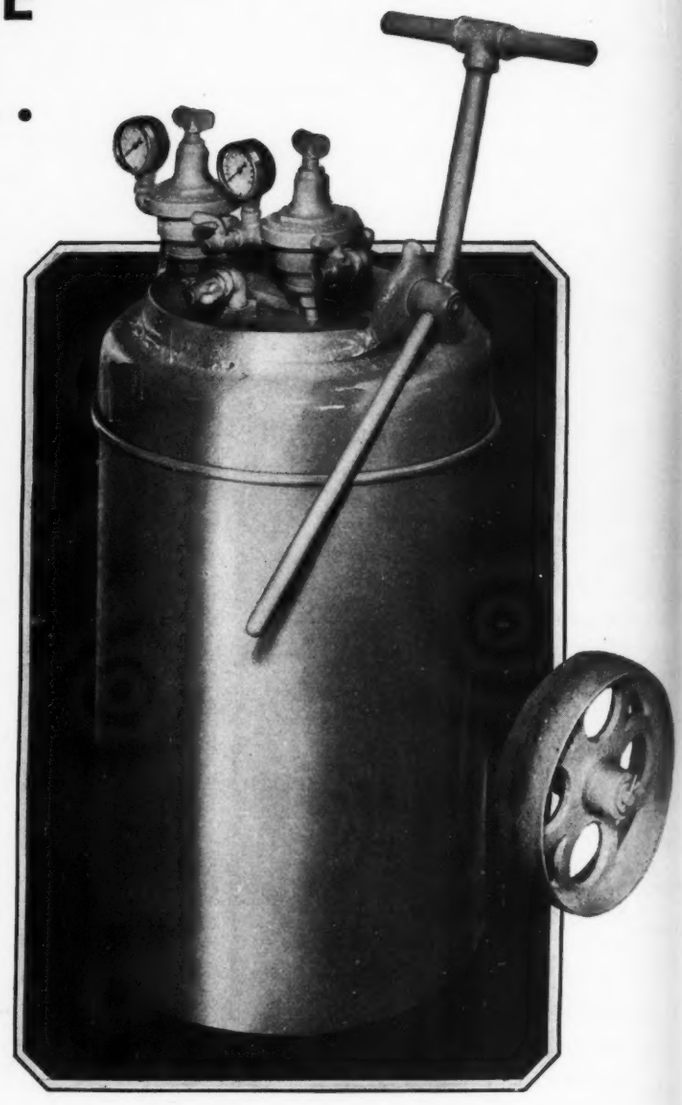
IN PROFITABLE REDESIGN.....

OXWELDING has enabled many manufacturers to turn out better metal products, often at lower cost, because it offers economies in production as well as complete freedom in design. Oxwelded joints assure the full rated strength of steel, or other materials. They can be made smooth and flush,—finishing is quicker and less expensive.

For instance:—A manufacturer of paint spraying equipment wanted a better joint for attaching chrome-molybdenum flanges to steel tanks. An oxy-acetylene welded joint proved more efficient and less costly.

But this was only a beginning. A Linde representative proposed redesign for welding,—relocating the cover flange joint to permit welding from the inside. This eliminated grinding which formerly was necessary prior to painting the tank. The use of a bronze welding rod, which was also suggested, required 17 minutes less welding time per tank and gave ample strength.

If you feel that redesign might improve your product, ask any Linde District Office how to obtain the full benefits of oxwelding and cutting. Write or 'phone, now.



Welding reduced the cost of the cover flange joint in this paint sprayer 68 per cent. Finishing costs were reduced approximately the same.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants — UCC — 627 Warehouse Stocks

IN CANADA, DOMINION OXYGEN COMPANY, LTD., TORONTO

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LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

M-R-C Precision Ball Bearing "Gurney Type"—with Bakelite Compound Ball Retainer especially adapted to high speed operation—as used in the supercharger of the Wright Model E Cyclone Engine.

IN FLYING six ships from San Francisco to Hawaii—a distance of 2,408 statute miles in 24¾ hours—The Navy surpassed its own previous performance made when these same ships flew from Norfolk, Va. to the Panama Canal Zone, a distance of 2,058 statute miles.

M-R-C Precision Ball Bearings in the Superchargers of the Wright Cyclone Engines gave a faultless performance at sustained high speed throughout both these record breaking flights. M-R-C Ball Bearings at other important points in the engines gave an equally fine performance.

For many years the builders of Wright Aircraft Engines have entrusted important bearing jobs to M-R-C. Their confidence has been more than justified by millions of miles of M-R-C dependable service.

You too, can safely depend on M-R-C for the correct solution to your bearing problem.

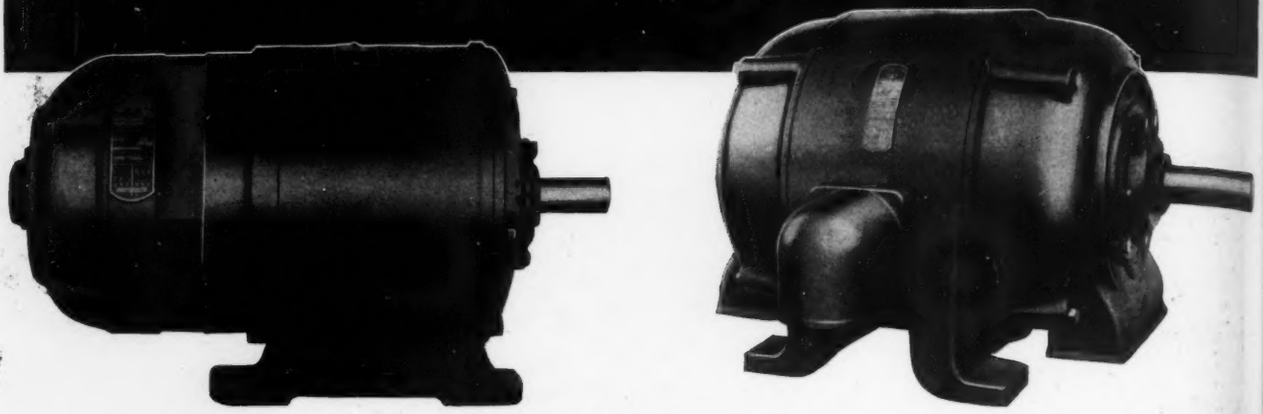
M-R-C Strom SRB Gurney Ball Bearings

MARLIN ROCKWELL CORPORATION, JAMESTOWN, N. Y.

M-R-C BALL BEARINGS

GURNEY · · · SRB · · · STROM

TWO MOTORS which offer designers a wide field for product improvement



Every designer of equipment that is driven by electric motor should read the engineering bulletins on these two new F-M Motors to fully understand the opportunities offered for improvement in performance and lower production costs.

F-M GEAR MOTOR

This motor is combination within one frame of horizontal motor and gear unit. It permits the use of more efficient, lower cost, high speed motor in place of the space consuming, costlier low speed types. The efficiency of the gear attachment is 97% or better—and ratios may be changed quickly and economically should such need arise. The engineer will, after reading these bulletins, also see the possibility, in some cases, of removing speed reduction mechanisms hitherto built into the machine itself—with consequent compactness and trim appearance.

F-M SPLASH-PROOF MOTOR

This motor is far more than the conventional open frame motor provided with housings to render a degree of protection. The F-M Splash-Proof Motor was designed from the beginning and in every detail is truly splash-proof.

Its protection is sufficient in many cases to permit its use in place of more expensive totally enclosed motors. If the service conditions imposed on your product call for motor protection from water, oil, other liquids, or *dust, dirt, lint*—by all means make a study of F-M Splash-Proof Motors.

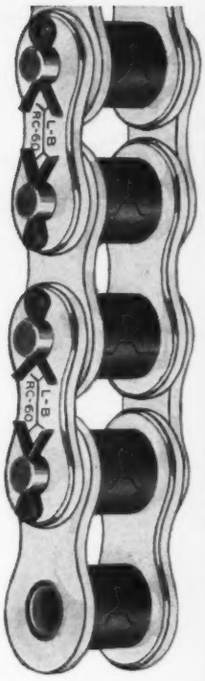
Full Descriptive Bulletins for Design Engineers

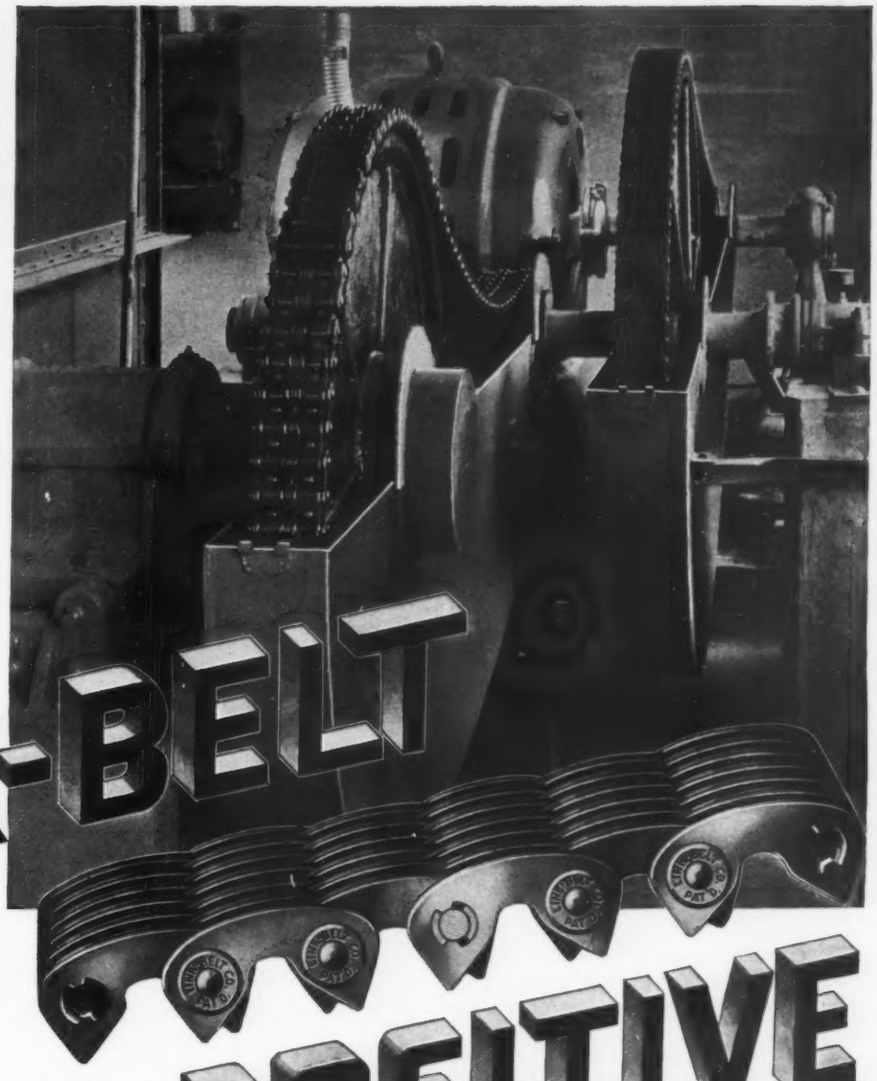
Of thought-stimulating interest to machine designers—you should read these bulletins. Write Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Illinois.

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 104 Years

FAIRBANKS-MORSE MOTORS

6037 EA 40-60





LINK-BELT POSITIVE

ROLLER & SILENT CHAIN DRIVES

A BETTER product, maximum production per machine, and reduced costs, result from the smooth, even, accurate turning of rotating parts.

Link-Belt Silent and Roller Chain Drives give this smoothness of power transmission, day in and day out. They unflinchingly transmit the full R.P.M. of the motor . . . smoothly . . . and do it over a long term of years . . . they last from one shop generation to another.

They are flexible, positive and efficient. They are made for practically any H.P., and carried in stock by distributors in sizes up to 60 H.P. for Silent, and up to 225 H.P. for Roller Chain Drives.

Start cutting down losses incurred through irregular power transmission. Send for Silent Chain Drive Data Book 125, and Roller Chain Data Book 1457.

Other Link-Belt Positive Drives Include:

Herringbone Gear Speed Reducers • Worm Gear Speed Reducers • Variable Speed Transmissions • Chain Drives of all types (Malleable Iron, Promal or Steel) • Herringbone Gears • Flexible Couplings

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Indianapolis, Ewart Plant
220 S. Belmont Ave.

San Francisco Plant
400 Paul Ave.

Toronto Plant
Eastern Ave. & Leslie St.

Offices in Principal Cities

Calendar of Meetings and Expositions

March 13-14—

American Railway Engineering association.

Annual meeting to be held in Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary of the association.

March 13-16—

Fourth Packaging, Packing and Shipping Exposition.

Annual display of equipment for modern packaging, packing and shipping to be held under the auspices of American Management association at Hotel Astor, New York, will include exhibits of materials, packaging equipment, machinery and supplies including bottle filling, gum taping, wire stitching and sealing machines, also packing and shipping room accessories, transportation and delivery essentials. John G. Goetz, 20 Vesey street, New York, is managing director of the management association.

March 26-30—

American Chemical society.

Semiannual meeting at St. Petersburg, Fla. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary of the society.

April 12—

Association of Iron and Steel Electrical Engineers.

Spring engineering conference to be held at Ohio hotel, Youngstown, O. John F. Kelly, 1010 Empire building, Pittsburgh, is managing director of the association.

May 1-4—

Chamber of Commerce of the United States.

Annual meeting to be held at Washington. D. A. Skinner, 1615 H street, N. W., Washington, is secretary of the chamber.

May 14-16—

National Petroleum Meeting.

Sponsored by the petroleum division of the American Society of Mechanical Engineers this meeting will be held in Tulsa, Okla., during the International Petroleum exposition. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the mechanical engineering society.

June 1—

Century of Progress.

International exposition opens for 1934 on this date. New and revised industrial exhibits will be included. Information may be obtained from Lenox R. Lohr, general manager, administration building, Burnham Park, Chicago.

June 19-21—

National Aeronautic and Hydraulic Meeting.

The aeronautic and hydraulic divisions of the American Society of Mechanical Engineers will hold a joint meeting at the University of California, Berkeley, Calif., during the summer meeting of the American Association for the Advancement of Science. Prof. B. M. Woods of the University of California is in charge of the meeting arrangements.

June 25-28—

American Society of Mechanical Engineers.

Semiannual meeting of the society to be held at Cosmopolitan hotel, Denver, Colo. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

June 25-29—

American Society for Testing Materials.

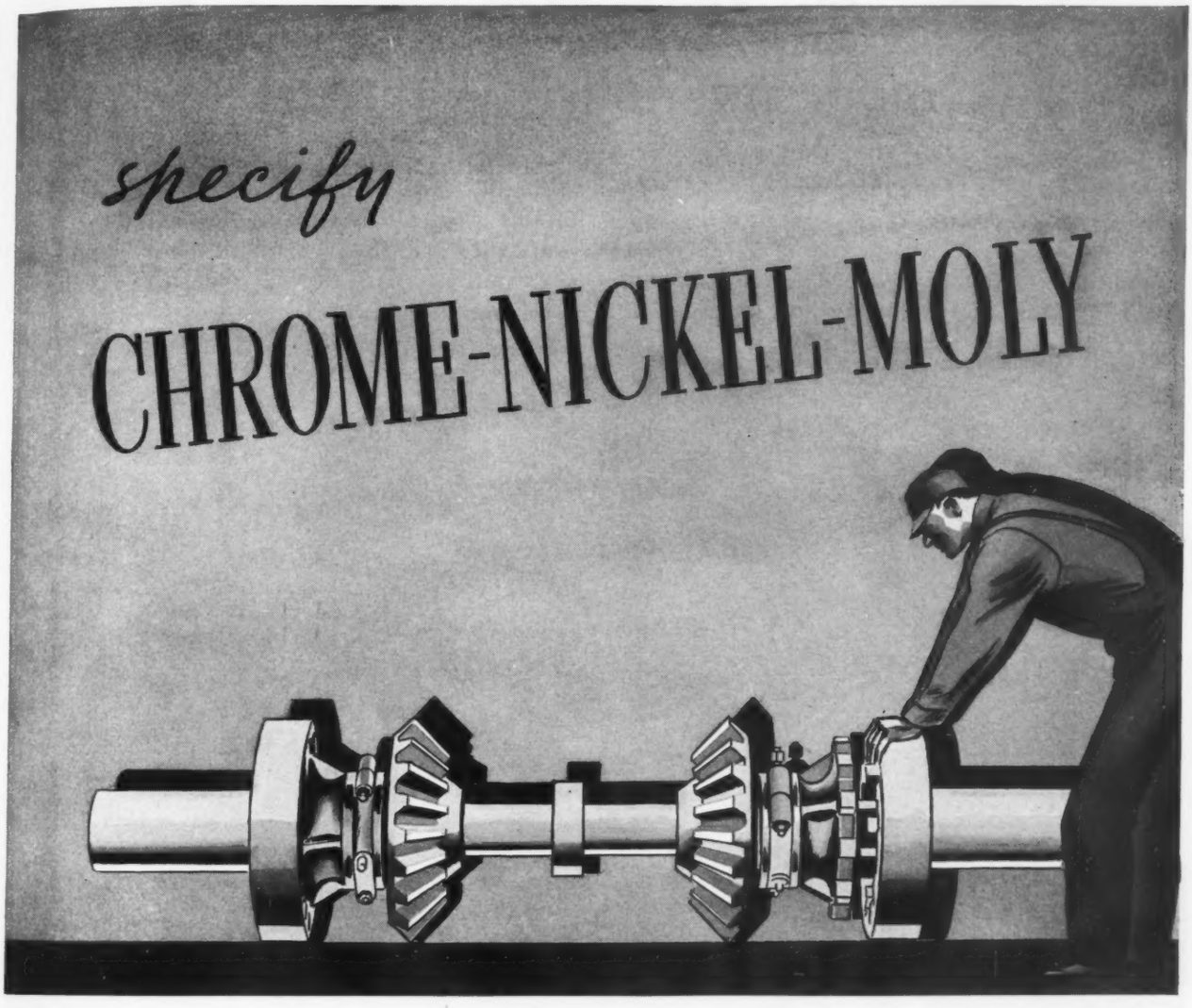
Annual meeting to be held at Chalfonte-Haddon hall, Atlantic City, N. J. C. L. Warwick, 260 South Broad street, Philadelphia, is secretary of the society.

June 25-29—

American Institute of Electrical Engineers.

Annual summer meeting to be held at The Homestead, Hot Springs, Va. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary of the electrical society.

TO PREVENT PART FAILURES WITHOUT CHANGING DESIGN



CHROME-NICKEL-MOLY is an outstanding steel for withstanding extreme torsional loads. It has unusual capacity for flowing torsional stresses until they are evenly distributed. Hence, failures are rare.

It is frequently specified where additional strength of a part is required without adding to size or weight, or where the expense of redesigning would be prohibitive.

Chrome-Nickel-Moly, despite its superior physical qualities, presents no unusual machining difficulties. In fact, it cuts as freely as the ordinary Chrome-Nickel steels of lower strength.

Complete information and counsel on the use of Chrome-Nickel-Moly may be had from our metallurgists.

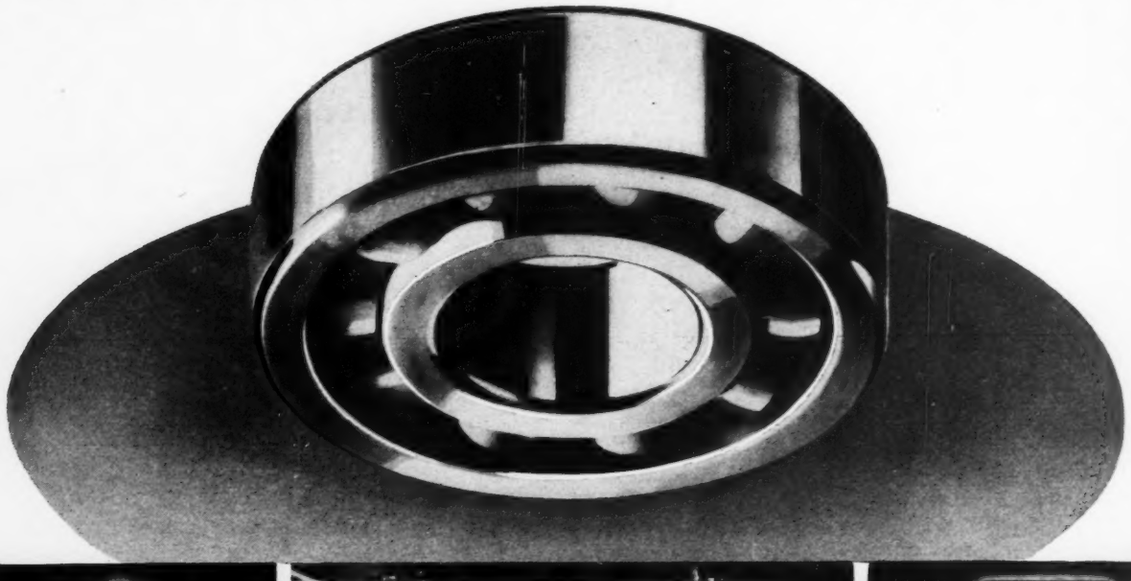
Chrome-Nickel-Moly requires the most careful control of rolling temperatures. Ingot sizes must be adjusted to the size of the individual heat. Cooling and finishing temperatures must be rigidly controlled. In short, special facilities, special techniques, special skill are required. Many exacting manufacturers can testify to the dependable and uniform quality of Illinois Steel Company's Chrome-Nickel-Moly.

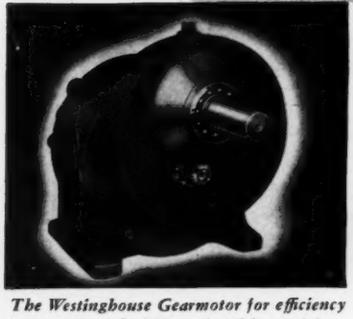
Illinois Steel Company
Subsidiary of United States Steel Corporation
208 S. La Salle Street, Chicago, Illinois

ILLINOIS *alloy* STEEL
ALWAYS DEPENDABLE

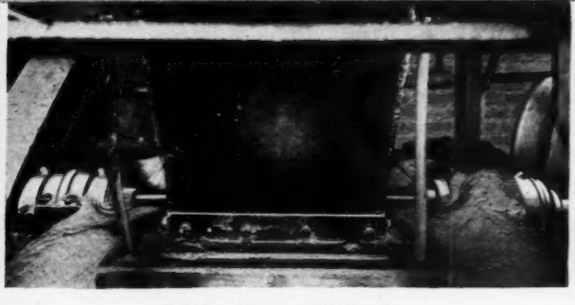
With higher costs modernization is now vital!

This increased labor cost! How will it be paid? How can we make a profit despite rising material costs? Prices must be such that demand for our products will grow, or the jobs already created will be jeopardized. But under the N.R.A. we must sell at a profit. How can this be done? We must turn to those to whom the worker and manufacturer owe so much—the machinery manufacturers of America. They have never ceased developments. They have produced equipment which provides profit despite curtailed volume. And plants with such equipment are ready with very favorable costs. They have found the answer with such machines as are shown below.

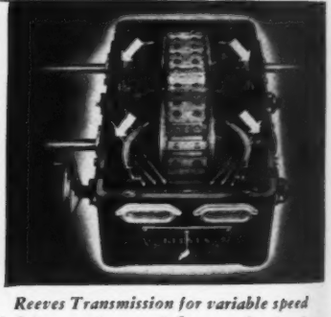




The Westinghouse Gearmotor for efficiency
Compactness, flexibility, simplicity and low upkeep—these features of the Gearmotor have helped it solve many transmission problems with the aid of Fafnir Ball Bearings.



25% less power on this breaker
Modernization of their soda ash breaker through the use of Fafnir Ball Bearing Pillow Blocks, produced this saving for the Los Angeles Soap Company. No maintenance has been needed for 3 years.



Reeves Transmission for variable speed
Infinite speed control from a fractional to 125 H.P. is supplied by Reeves. A profit producer which provides dependability with the aid of Fafnir Ball Bearings.

Sanford-Day cuts handling costs
A new mine car with Fafnir mine car wheel bearings is doing its share in making profits for the mines. Less tractive power is required . . . longer life is assured . . . both maintenance and lubricant required have been greatly reduced.

2½ H.P. saved every 40 ft. line shaft
H. P. Snyder Mfg. Co. obtained this profit with 6 Fafnir Hanger Boxes—$92.00 a year saved on power alone. In lubricant $2.40 a year less—greasing 4 times a year instead of weekly oilings. Of course they bought more—it pays.

Ways and means of cutting costs through new machines, and modernized equipment, are treated in detail in every issue of "The Dragon". We will gladly include you on our mailing list.

Let us cooperate—what has been done for others can quite likely be done for you. We will gladly help you save through modernization whether it be machinery or power transmission equipment. Just drop us a line. The Fafnir Bearing Company, *New Britain, Conn.* Atlanta . . Chicago . . Cleveland . . Dallas . . Detroit . . Milwaukee . . Minneapolis . . New York . . Phila.

FAFNIR BALL BEARINGS

MACHINE DESIGN

THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO

March, 1934 Vol. 6—No. 3

Cut Waste—Use Modern Numbering Plan!

By M. W. Elmendorf

Chief Draftsman, Taylor Instrument Cos.

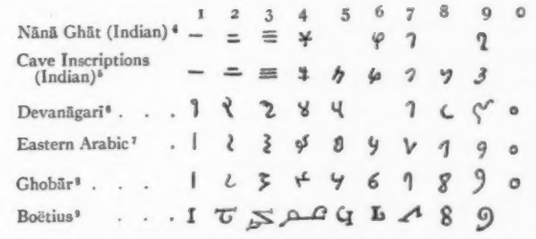


Fig. 1—Ghobar numerals more nearly approach modern forms than other historic type

Fig. 2—In Symbol-type numerals it was necessary to introduce new forms for higher values

Courtesy 11th Edition, Encyclopaedia Brittanica

SATISFACTORY plans for numbering items in large groups of objects seldom receive proper attention until the inadequacy of the chosen system develops serious difficulties. These may force the adoption of a new system with the attendant cost for changing. In large organizations, or mergers, the changeover becomes a major operation and must be accomplished gradually, without interrupting regular routine. When determining the best system to adopt it is necessary to review all existing numbering schemes, and this becomes a problem when it is realized that little reference can be found in handbooks regarding the organization of part numbers.

Examples from numerous firms will show a wide divergence in schemes, being mostly built up over a period of years to suit their particular application. When analyzed, all will be found to have their root in one or more of the basic systems herein described. This article is offered as assistance to those inaugurating a new system or supplanting an old one.

I—Part Numbering Systems

(*a*) *Definition:*

A part number system comprises an adequate program of abbreviations which definitely designate, or designate and classify, all items or groups of items in the form of an established code.

(*b*) *Brief History:*

The *Encyclopaedia Brittanica* tells us that the use of visible signs to represent plurality is older than

writing, and today we count by tens because our ancestors first counted on their ten fingers. This simple plan expanded until it was capable of expressing all numbers below 10,000 but was purely indicative, so that single strokes began to be used to record numbers. These naturally grew to be lengthy when the number reached ten, consequently new signs were introduced *Fig.* 2.

In India the use of numerals without zero dates back to the early part of the third century B. C. and, though authoritative opinions vary as

TRACING INDEX — OUT OF FILE FOR
PART NO. 70R47P24 — SIZE OF SHEET 8½"x11"
DESCRIPTION Regulator Pilot Valve Tube
CUSTOMER'S NAME None
MATERIAL .196" O.D.x.060" I.D. Seamless Steel Tubing Specif. #TD7
DRAWN BY J. M. — SCALE Full Size
FOR REVISIONS SEE CHANGE ORDER NO. R11553
REMARKS — DATE 6-7-33

Fig. 3—Combined letters and numerals can be quickly read on any office records

to the transmission means, they somehow spread through Eastern Arabia and finally reached Europe in the form of the Ghobar numerals, *Fig.* 1, which are almost identical to our present day numerals. During this evolution the various alphabets also assisted at different periods in designating numbers above nine. From these humble sources all part number systems obtain their symbols with variations to suit numerous applications.

(*c*) *Purposes:*

The primary purpose of all part number systems is to supply abbreviated symbols for more efficiently representing and self-indexing the rather lengthy descriptions which otherwise would be required to designate and classify each item of any group to be coded.

Secondly, an adequate part number system has for its purpose a uniform plan to speed up all of the natural functions relative to handling the items in every division of an organization and to some extent by its customers. Part numbers may be written or spoken a number of times daily.

The final test of any system is whether or not it pays for itself. Although it is not customary to check this point on accepted part number systems, the fact remains that practically all modern concerns operate by means of some such system and find them indispensable.

(*d*) *Kinds:*

The six basic part numbering plans are alphabetical, numerical, combination of alphabetical and numerical, phonetic, group, and Dewey Decimal System. Some firms combine two or more of these into one adaptation.

II—Discussion of Various Plans

(*a*) *The Alphabetical System* is generally based on the twenty-six letters of the English alphabet for convenience in typing, etc. but it is adaptable to the alphabet of any language. In use, the letters are distributed over the main classes or sub-classes, and details are formed by prefixing or suffixing other letters. For example: A=Atomizers and AA=Atomizers 1-inch size and AAA=Atomizers, 1-inch size, body detail, AB=Atomizers, 2-inch size, etc.

(*b*) *The Numerical System* is based on the ten numerals, which in combination approach infinity but gradually increase in length. In general use each succeeding item is given the next consecutive numeral without regard to classification. For Example: No. 21980=*Bracket* for Apron Support, while No. 21981=*Stud* for Dial and No. 21982=Assembly of 8-inch Valve. Some users delegate groups of numerals to certain classes of items, or divisions or an organization.

(*c*) *The Combination Alphabetical and Numerical System* uses both the letters of the alphabet and numerals alternately. The main classes of items may be distributed over either the alphabet or numerals, and the sub-classes and details signified by alternate letters or numerals as the case may be. For example: M=Motors and 1M or M1=Motors, single phase and 1M1 or M1A=Motors, single phase, 1 horsepower. Some users add a dash between each digit thus 1-M-1. Lower case letters of the alphabet are also included in some systems as No. 18T7f, per U. S. Navy Specifications.

(*d*) *Phonetic System* (coded) requires that certain words from a standard dictionary be applied to each distinct item but usually uses words of the same length and beginning with the same letter to classify certain groups, or may choose certain forms of knowledge as fruits, or vegetables, to designate classes. For example: "Pale"=1-inch Valve, brass trim, etc. while "Palm"=1-inch Valve, iron trim, etc. Also "Apple" = 20 gallon tank and "Pear" = 40 gallon tank. Another phonetic scheme is to use the first letter of the main description of each variable. For example: BVBT = Brass Valve, Bronze Trim, etc. There are many variations of this system for use in catalog description abbreviations.

(*e*) *The Group Plan* rules that once any symbol has been applied to a certain class of item, and all subsequent items of this class do not vary too much dimensionally, each succeeding part number will carry the basic symbol, but add Gr. 1, Gr. 2, Gr. 3 etc. to show the vari-

ations. For example: No. 18642 = Plain unfinished *iron* link 4 inches long and No. 18642 Gr. 1 = Plain unfinished *brass* link 4 inches long and No. 18642 Gr. 3 = Polished Nickel Plated Brass link 4 inches long. There are infinite variations.

(*f*) *The Dewey Decimal System* was developed in 1873 by Dr. Melvil Dewey, who as Director of New York State Libraries was confronted with the problem of establishing a program of numbers to be applied by state librarians to millions of books. The system had to classify the entire field of knowledge and thus supply a uniform index for statewide use. Dr. Dewey began by dividing the world field of knowledge into 9 chief classes keeping 0 for miscellaneous. Each division is again separated into 9 sections with the tenth delegated to special purposes and this process can continue by lengthening the symbol to suit. For example: 625 = Railroad Engineering Useful Arts, where "5" designates (Railroad Engineering) of Division "2" (Engineering) of class "6" (Useful Arts) and there can be further sub-divisions such as 625.24 to designate Freight Cars. A full explanation of this system can be found in *Decimal Classification and Relative Index* by Melvil Dewey, Malld, Forest Press.

(*g*) *Applications*:

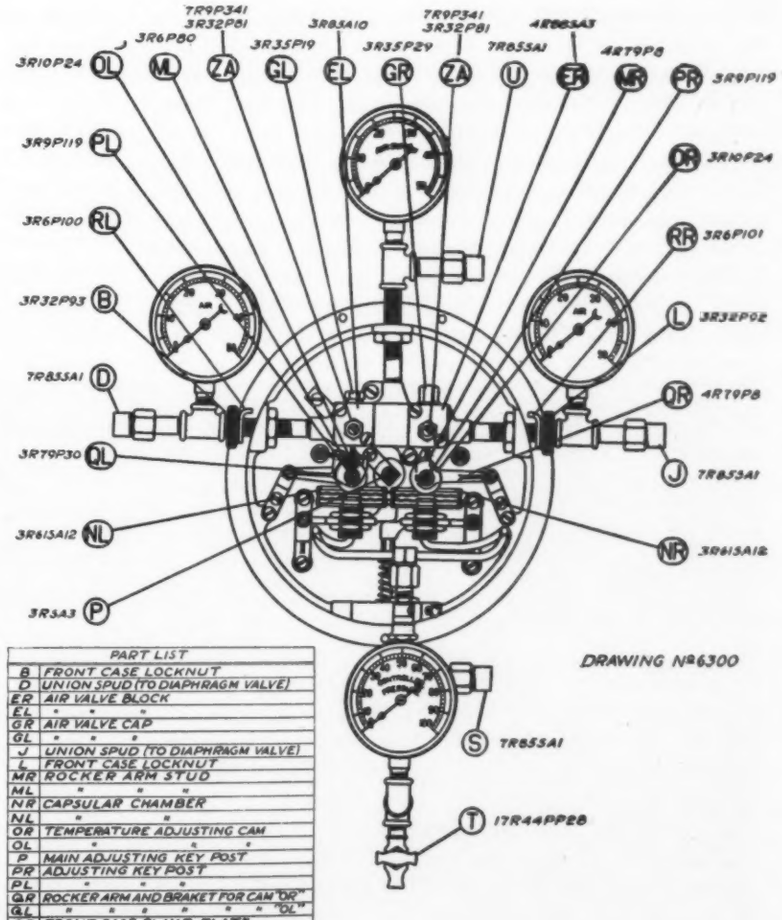
The Alphabetical System is limited in its application to the number of letters contained in the alphabet chosen. In the English alphabet only 24 characters are practical since the letters "I" and "O" could be confused with the numerals one and zero. Thus, single position symbols can be obtained to cover 24 different objects, and double symbols would furnish the square of 24, or 576 two place symbols, and three place symbols could be obtained to the extent of 13,824, while a six place symbol would deliver 191,103,076 different symbols using only the 24 alphabetical characters in combination.

The Numerical System, based on the Arabic numerals, furnishes only 10 symbols in the single position, 100 in the double position, 1000 in three position and only 1,000,000 in 6 digits. Groups can be reserved for any desired purpose but said groups cannot be expanded without recourse to a new series usually quite distant from the original.

The Alphabetical and Numerical System can begin by classifying first into 24 alphabetical groups in the single place symbol, then prefixing or suffixing single numerals will increase the classifications to 240 combinations limited to not over 2 digits. Adding another set of 24 letters will give 5760 classifications in not over 3 digits, while using alternate letters and numerals up to 6 digits will supply 18,144,000 classifications. A part number could look like this—A1C6T3—and requires no separators.

The Phonetic System is limited only by the number of words obtainable from the English dictionary having the desired classifying qualities and many times it is found necessary to depart from real words and resort to additions from the alphabet. This system is used mostly in telegraphic codes for catalog items.

The Group Plan allows any existing system to be expanded easily by supplementing the group numerals after any already accepted symbol,



PART LIST	
B	FRONT CASE LOCKNUT
D	UNION SPUD (TO DIAPHRAGM VALVE)
ER	AIR VALVE BLOCK
EL	" " "
GR	AIR VALVE CAP
GL	" " "
J	UNION SPUD (TO DIAPHRAGM VALVE)
L	FRONT CASE LOCKNUT
MR	ROCKER ARM STUD
ML	" " "
NR	CAPSULAR CHAMBER
NL	" "
OR	TEMPERATURE ADJUSTING CAM
OL	" " " "
P	MAIN ADJUSTING KEY POST
PR	ADJUSTING KEY POST
PL	" " "
QR	ROCKER ARM AND BRAKET FOR CAM "OR"
QL	" " " " " " "OL"
RR	FRONT CASE CLAMP PLATE
RL	" " " "
S	UNION SPUD (CONTROLLED PRESSURE)
T	DRAIN COCK
U	UNION SPUD (AIR INLET)
ZA	ADJUSTABLE AIR LEAK

Fig. 4—Part numbers for similar parts or for similar machines are related readily in the combined system of numbering

thus forming additional classifications for all expansions by adding "Gr," or similar indicator, and a numeral to each variation. Thus, if No. 2184 is the existing part number and it is desired to supply it in 3 variations, simply use No. 2184 Gr. 1, No. 2184 Gr. 2, No. 2184 Gr. 3.

The Dewey Decimal System is very comprehensive but designed to be used by the higher grade operators. It is of a true indexing nature and depends on the decimal point and Arabic numerals mostly. Although developed for libraries, it can readily be applied to industrial organizations. It is practically unlimited in expansion. In its application, time and expense will be saved by closely following the plan in Dr. Dewey's book, substituting standard parts for items in the world of knowledge. The use of decimal points in factory numbers is risky but another more suitable separator could be used.

III—Conclusions

This rather brief treatise only sketches the outlines of the various systems, but their advantages and disadvantages may be summed up briefly. The alphabetical system gives the greatest ratio of variations to the length of symbol but is apt to cause some errors in verbal and telephone orders. It does not require separators of any kind and is applicable to typing, printing or writing. It is truly a system of symbols, not numbers, because no numerals are used. It is confusing when the symbol happens to be identical to spelling a common word.

The straight numerical system has been the most universally used, since it requires no program unless groups of consecutive numerals are reserved for certain classifications. This plan usually wastes large groups of numbers thus unduly increasing the ultimate length of the symbol. The only means of expansion requires adding letters after the numerals which then brings the symbol into the combination numerical and alphabetical plan. If letters are undesirable, dash numerals as No. 19821-5, can be resorted to, but again we find the scheme reverting to the group plan. The only recourse left is to ascertain the last numeral chosen and take the next consecutive numeral. This naturally throws these part numbers out of the self-classifying type and forces the use of cross index files for classification purposes. It is generally conceded that the straight numerical plan is the most simple to operate but requires more set-up material and longer symbols over a great number of variables. This plan gives the lowest ratio of variations to length of symbol.

The combined alphabetical and numerical plan is becoming prevalent because of its flexibility, brevity and self-classifying feature. It lends itself to easy expansion without disrupting classifications. It is adaptable to assemblies, sub-assemblies and details. It requires no separators as the alternated letters and numerals are definite and less errors are encountered because the long numerals are split up by the letters. Its efficiency is shown by the fact that using only one letter prefixed by 1 to 99 and suffixed by 1 to 99 (Examples No. 1P1 to No. 99P99) we get 9801 variations in five digits. By merely using 24 available letters in the above combination we increase the variations to 235,224 without lengthening the symbol. This is an increase of 135,225 variations over the straight numerical plan in a five digit symbol, giving only 99,999 variations. This plan gives the third highest ratio of variations to length of symbol.

The phonetic plan is used to conserve telegraphic charges which would be excessive for written descriptions but are economical when coded according to words from a dictionary or merely combinations of letters without meaning. This plan is closely allied to the pure alphabetical plan and gives the second highest ratio of variations to length of symbol.

Variations Are Increased

To lengthen the life of any numerical plan, the group plan serves to increase the variations by the addition of the "Gr." number only, and does not disturb the existing classifications. Many instances will be found where the various items can be placed on one tabulated drawing, thus saving drawings, filing space and blueprints. It may be said that the group plan is a good method to patch up any prevailing numerical system where the expense of installing a complete new system is not warranted.

The Dewey decimal system requires no further discussion as it is fully explained in the book previously mentioned in this article. It is more academic and primarily designed for librarians but is suitable for use with any high grade operators.

The ideal part numbering system, to be covered more extensively in a future issue, would consist of a most simple program to produce unlimited, brief and definite symbols which are applicable to descriptions of all units throughout any organization. They must function speedily and accurately by sight or hearing with the least possible supervision or reference. They must predominate to the exclusion of all other symbols and should be universal for standard commercial items throughout the country. They should be controlled by a part number committee and issued under a standard routine plan. They must be self-indexing and automatically classifying. These qualifications are rather exacting but are essential to produce a plan which is workable from origination to completion and capable of performing the many requirements necessary.

SCANNING THE FIELD FOR IDEAS

ON NUMEROUS occasions suggestions have been made in these columns to stimulate the engineer's search for design ideas. One source, however, which has not been stressed particularly heretofore is the research laboratory. This industrial channel frequently is a hot bed for innovations of the type fittingly referred to as byproducts of research

Typical is an interesting case recorded recently. It was necessary for research engineers of a large company to devise a new motion within a moving picture projector to provide better control of film movement. During the development procedure the engineers discovered that the principles of this arrangement formed the basis of a new inertia-controlled shock absorber for automobiles.

Keep an eye open for byproducts when studying existing designs! They may bear profitable results.

GASOLINE AS A COOLANT

BY UTILIZING gasoline as a cooling medium for an electric motor a radical departure in design has been effected in a pipeline pumping station. The centrifugal pumping unit, *Fig.* 1, in which this idea was carried out is designed for outdoor operation without housing of any kind. The use of the pumped fluid as a coolant is in a category with a new cooling system using the lubricating oil of an engine instead of water. Although details are not available, it is reported that the Spontan Co., Stockholm, Sweden, has a new invention that embodies a radiator system of new design, said to do away with disadvantages of the water-cooling system, such as freezing, clogging, and boiling while keeping the motor's temperature virtually constant regardless of whether the engine is doing heavy or light work.

Built by Allis-Chalmers for the Great Lakes pipeline, the fluid for transferring heat away from the motor of the Rannett unit (below) when used as a booster in a continuous line may either cool the motor before passing through the pump or after. Equipment manufactured to date has had the cooling on the suction side. Since the cooling fluid passes through a double jacket around the motor it simplifies construction and reduces costs to have the working pres-

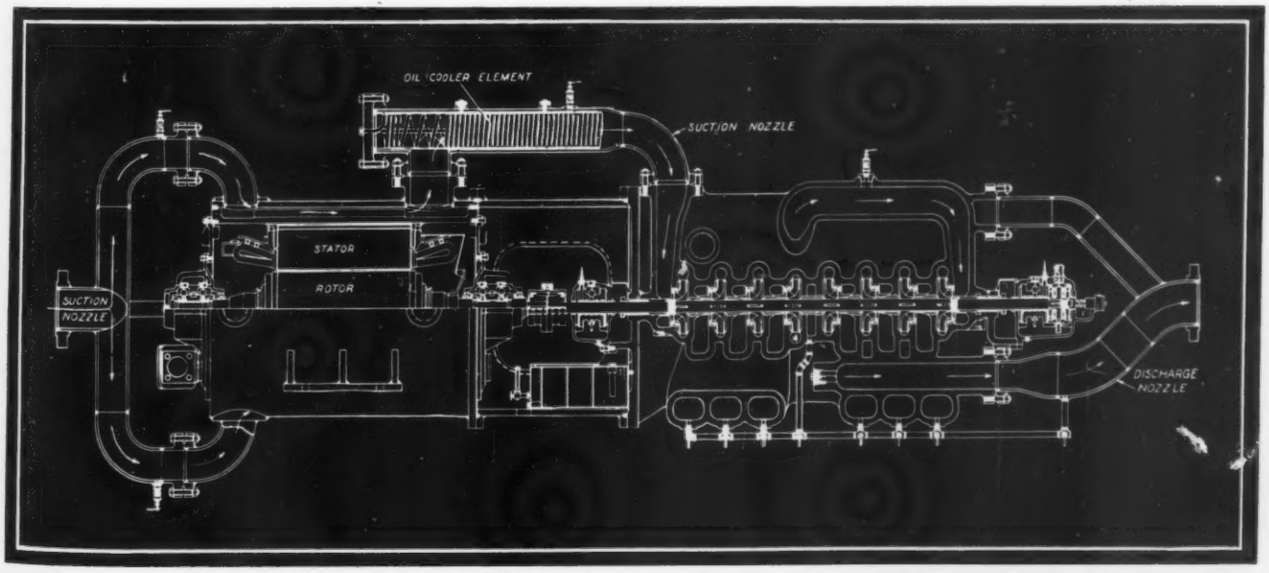


Fig. 1—*Gasoline being pumped contacts housing of motor to conduct heat away, thus serving as a cooling medium*

sures through the jacket as low as possible.

Motors employed are 400 and 700 horsepower on the two sizes built. By removing heat from the outside shell of the motor less clearance is required between the rotor and the stator, resulting in a higher power factor and saving in electrical energy. Original design of the motor housing was a double-walled steel casting. This, however, was abandoned for welded chrome nickel steel plates to insure against possible porosity and cost of intricate patterns.

NOW INTERNAL CENTERLESS GRINDING

EXTENSION of the centerless principle to internal grinding marks another progressive step in the machine tool industry. Not only is the machine, *Fig.* 2, an achievement in mechanical design, but the new process is destined to

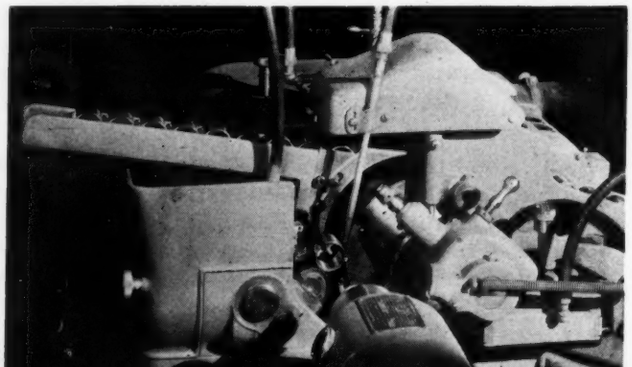


Fig. 2—Hydraulically controlled rolls are key parts in new internal grinder

have far-reaching possibilities. Three rolls—regulating, pressure and supporting, controlled hydraulically with loading and supporting arm are the key units. The supporting roll is fixed below the work, while the pressure roll mounted on a swinging bracket keeps the workpiece in contact with the other tools. Work is driven by the regulating roll.

With the work in place, the table carries the piece to the grinding wheel. The wheel, about to enter the hole, backs away from the work surface and by a pickup feed comes into contact with the surface with a plunge cut; this plunge cut prevents breaking down the corner of the wheel. When the piece is ground to size the loading arm swings upward, ejects the finished work, and at the same time brings down another workpiece for grinding. This machine assures concentricity of bore with the outside diameter of the workpiece within 0.0001-inch. Heald Machine Co. is building the unit.

EMPLOYING THE HEAT PUMP

ONE of the many innovations in the Westinghouse experimental house at Mansfield, O., is the use of the reversed refrigeration process to heat water. In this case the type of compressor used in a refrigerator has its operation reversed in order to provide heat instead of cold. Water from a storage tank is circulated through the compressor unit and there picks up heat during the cycle of changing the refrigerant from a gas to a liquid. Most of the heat used to raise the temperature of the water about 140 degrees is extracted from the atmosphere of the room, the compressor acting as a heat pump. By utilizing all the heat losses of the motor and compressor, in addition to the other processes, a heating unit with a high efficiency has been developed.

BELLCRANK ELIMINATES GUIDES

BY MEANS of a bellcrank which supports a valve needle in a swivel joint full floating features have been embodied in a new automatic expansion valve, *Fig.* 3. The floating design avoids the use and possible sticking of sliding stems or guides. Bellcrank *K* is actuated

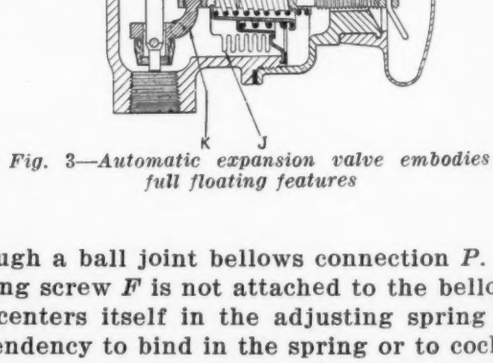


Fig. 3—Automatic expansion valve embodies full floating features

through a ball joint bellows connection *P*. Adjusting screw *F* is not attached to the bellows *J* but centers itself in the adjusting spring with no tendency to bind in the spring or to cock the bellows out of alignment. One end of the bellows is seated into the body of the valve and soldered to it. Two concentric springs opposing each other are provided so that the valve will operate under either a vacuum or pressure.

This unit was designed for use as an evaporator control on electric refrigerators by E. R.

DeLuiz for American Injector Co., Detroit. For sulphur dioxide a Stellite needle and a stainless steel seat are provided; when the valve is to handle methyl chloride a Hastelloy needle and Monel metal valve seat are employed.

AVOIDING FINE SCREW SYSTEMS

USE of compound threads has been more or less common practice in design over a period of years. It is interesting to note, however, that supplementing their many applications is the employment of a differential screw system, *Fig.* 4, on the new Fitz Micro-Manipulator manufactured by Bausch & Lomb to handle small objects or cells in the field of the microscope during observation. The arrangement obviously avoids the serious disadvantages of a fine screw system for controlling thrust motion. By rotating a control handle the system is actuated through spring coil *A* upon hollow screw *B*. One complete rotation advances the screw 1/30-inch into its nut *C*. At the same time screw *D* is drawn back 1/36-inch into the inner end of screw *B*. The difference of these two motions, 0.0055-inch, is the amount of advance of rod *E*.

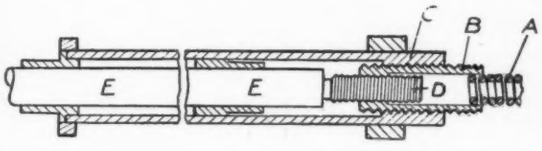


Fig 4—Differential screw is employed for controlling thrust motion

BEARINGS ALLEVIATE THRUST

SUPPLEMENTING the brief reference to the Sterling crankless diesel engine on page 42 of the February issue, the mechanical bearing units which transfer the power from reciprocating pistons to rotating disks involve exactly the same principle as that employed in Mitchell or Kingsbury thrust bearings. Power generated by the pistons is transferred to inclined disks, *Fig.* 5, mounted on a straight drive shaft at each end of the engine.

The engine is of two-cycle design, burning a low grade of fuel oil. Operation on the two-stroke cycle makes possible the use of the Michell shoe without adequate form of take-up on the opposite side of the swash plate. Piston rods always are in compression. Even when the ports are open and there is no cylinder pressure the inertia forces at the outer end of the stroke naturally keep the shoe in contact.

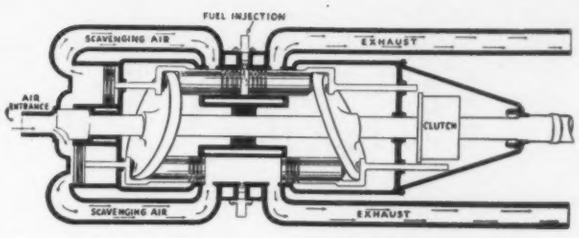


Fig. 5—Piston rods are always in compression in new crankless diesel engine

Continual thrust on the pistons tends to eliminate piston slaps which are unavoidable in the larger crank-type engines. This thrust in the Sterling engine does not reverse and become immediately opposite as in crank systems but the reversal is effected by traversing the direction of the line of thrust around the cylinder bore in unison with the wash plate movement.

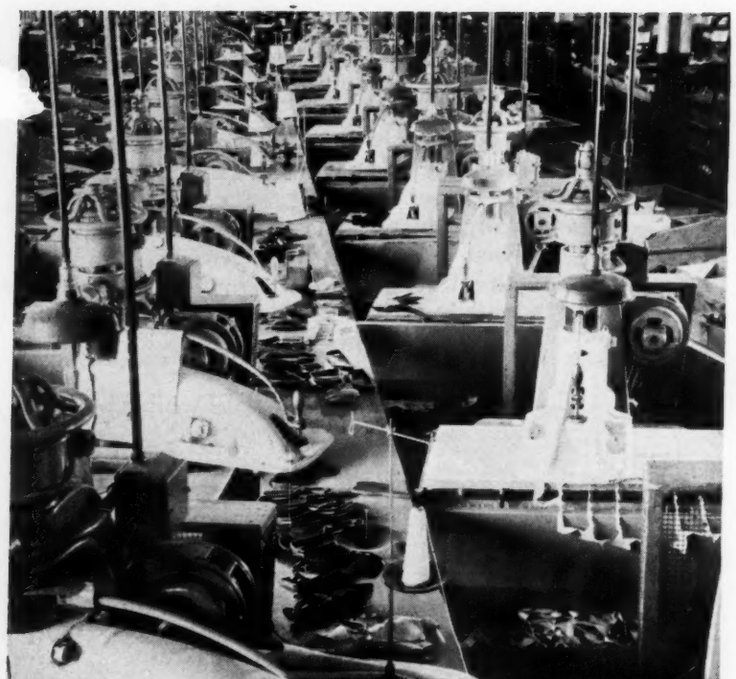
NEW USES FOR SPEED NUTS

ADOPTION of the speed nut type of fastening used in the stove industry, by leading automobile, refrigerator and electrical equipment manufacturers commands attention. It constitutes another example wherein an idea finds new applications in other fields. When a stove builder found that it was not practicable to use drive screws he devised what might be described as a combination nut and lockwasher, *Fig.* 6. This speed nut is spring steel, arched, with prongs extended and set at an angle to engage bolt threads when flattened. Parts are held firmly, yet the resiliency allows for expansion or contraction of the components and also for vibration. Its permanently tight grip even under vibration appeals particularly to automotive engineers.

Fig. 6—Combination nut and lockwasher materially speeds up assembling operations

Bright Colors on Machines A

By T. J. Maloney
New Jersey Zinc Co.



FOR years machine tool builders have standardized on one color, gray. In fact, that particular gray became so widely known in industry it assumed its logical classification and became "machine tool gray," as distinct a color meaning in its sphere as is "battleship gray" in another. The standard is still the same, but the widespread adherence of machine builders to it is on the wane. Why? Why is brighter color beginning to be utilized in the capital goods industries as it has been in consumer products?

For numerous reasons, some that are soundly progressive, and some that are merely part of the constant change in our living and working conditions. Among the latter, the very fact that the standard has so long held a more or less autocratic sway to which colors—any and many colors—are a direct rebellion, is no small factor.

But more important are certain advantages that accrue to the use of color. The lighting authorities of our leading electrical companies have daily stressed the value of light color to the workman and to the employer. Easier work through proper contrasts. Greater shop efficiency, lower unit production costs, and often fewer rejections before inspection, fewer returns afterward. The paint industry has preached the same gospel, stressing the value to plant, employe and employer of the proper ensemble of high light reflecting (meaning white or very light tint) wall surfaces and bright, cleanly colored machinery.

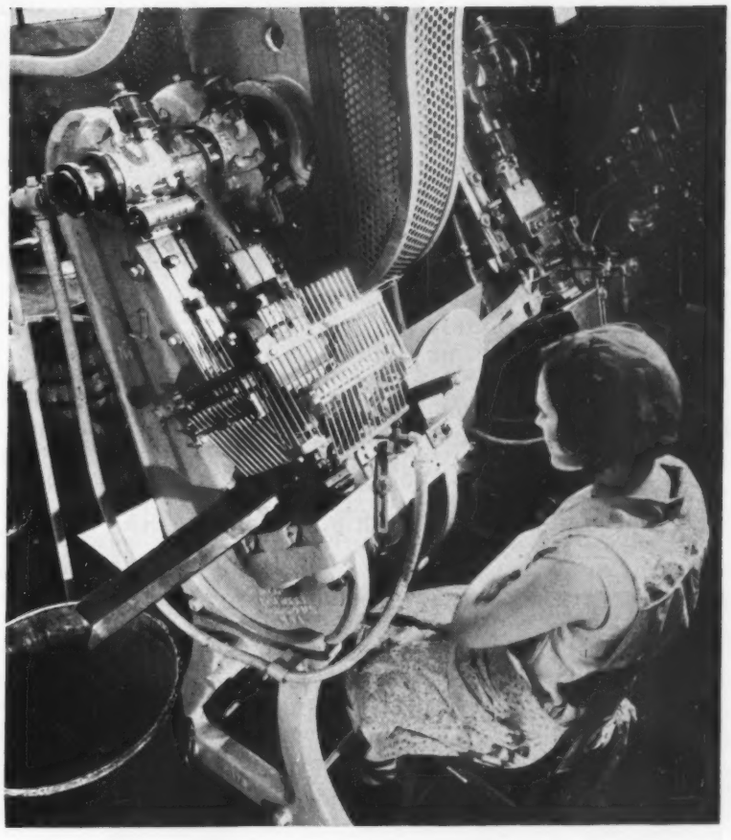
Nor have certain machinery manufacturers been slow to realize the sales value of following the color trend. Many of the large customers in the automotive, electrical, and even the steel industries, demanded certain color schemes for their machines. At first a slight premium was paid for this extra effort, but today color is given as demanded, and color is often introduced as a sales weapon by the awakened manufacturer.

Machines Are Made Conspicuous

Certain small tool manufacturers have seen the advantage of bright colors in making their machines conspicuous in surroundings in which they would otherwise be lost. Orange stapling machines and portable drilling units are examples. Manufacturers of electric trucks might profit by coloring all moveable equipment in bright red and orange to make it as garishly visible as possible, thus making its path easier to clear, and accidents to both personnel and product less likely. High visibility can be used to practical and to sales advantage in numerous types of equipment. If a large firm using various high and low voltage electrical devices and

A Operating Efficiency

Fig. 1—(Opposite page)—Cutting room machinery in white and green gives orderly impression. Fig. 2—(Right)—Use of bright colors tends to eliminate operating hazards by effecting high contrasts



indicators recolors not only these devices, but a certain floor and wall area surrounding them, so that they literally shriek "danger" the company making this equipment might advantageously borrow the idea and let the equipment carry it to every prospective client. Color can and does talk.

Another and wider aspect of this question, which will serve to indicate to the designer the attitude of the user of his machines, can be illustrated by the work in progress in two well known companies, one manufacturing various types of saws, the other in the scale business. The former has completed a new factory, and that factory incorporates everything that advanced knowledge of manufacturing in general and their own problems in particular can give. As there are no windows in the plant, a new type of lighting unit to simulate daylight must be employed. What would you expect the appearance of the machinery to be?

The management expects it to be an orange, but not too vivid. Colors which have brightness and on short association have a tendency to be dynamic, have the shortcoming of wearing hard. But this manufacturer experimented with orange in his old shop in the early days of the depression and found a pick-up in output when the operators worked on these machines. He also found that not only the machine but the plant itself was cleaner when the machinery was brightly colored.

The familiar objection of the ugliness of oil on light colored surfaces was overruled by the workers who saw the oil readily and easily and removed it at once. In the use of colored shoe machinery it was found that operators who had taken two hours of the company's time once a week to clean up, did the cleaning operation daily and in minutes instead of hours once the colors were definitely established.

To return to the second plant, ground for which will soon be broken, the construction is of an opposite nature, as much space as possible (meaning all wall space) being glass. Any part of the interior will have a minimum artificial or daylight illumination of nine foot candles of light and a maximum of fourteen. Ceilings are to be white to give both types of illumination the greatest aid. The machinery is to be colored in light pastels, the blues and greens predominating because of their cool value, the ease of these colors on the eyesight of employes, and their contrast value for most of the operations and assembly.

Demand for Color Is Strong

These two plants show a trend that is as apparent in the industrial building to be, as it is in office and home construction. Lighter and

simpler plants with more thoroughly comprehended aids to the workman are the order of the day. Color will be a part and parcel of the machinery. The demand is there—so strongly there that the executives in these plants are meeting the problem themselves, but it should be a design job.

Rejections Are Reduced

On machinery for a radio tube plant it was found that the use of orange and pastel blue, the first for color contrast with the greens and blues of a stemming machine, the second for general recoloring and for the cool values blue offers a hot industrial plant, reduced the number of tube rejection to a figure far below the pre-color number.

Colored machinery has been proved a particular asset in the shoe industry. Two of the country's largest plants use different color groupings in different divisions with unqualified success. Unfortunately the photograph of a machine and a division as colored by one of these companies, *Figs.* 1, 3 and 5, is in black and white. Even so, the whole aspect is one of marked cleanliness and brightness and the dress of the operator alone illustrates the betterment in working conditions.

A thorough survey of both plants stresses the following benefits of colored machinery in this industry: Eye strain was greatly reduced, resulting in the amount of rejected products and damaged materials being greatly reduced. (This reduction in a plant noted for high quality workmanship); older employes being given a better chance to compete with the younger eyes; a distinct lessening of fatigue and nervous tension; decrease in accident rate, and resultant decrease in insurance rate; and improved morale.

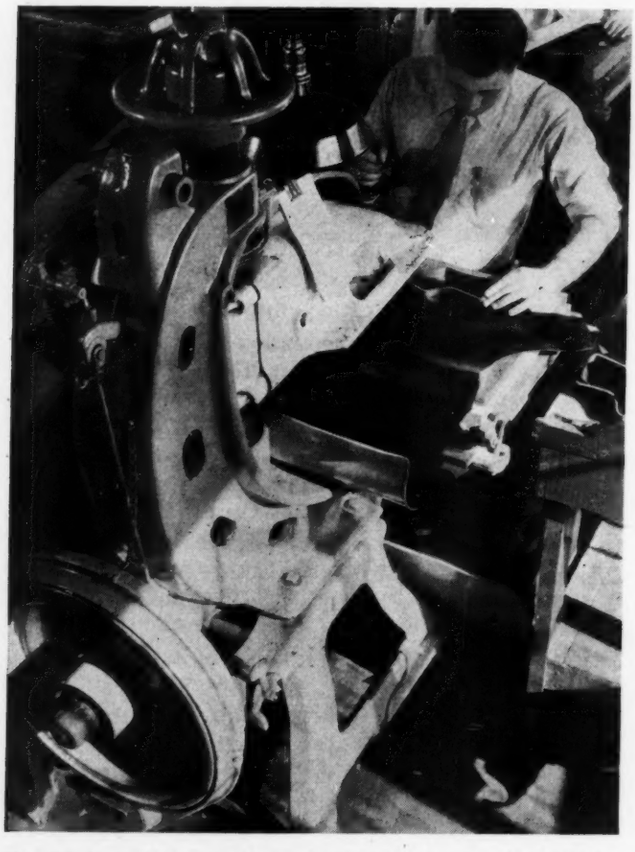


Fig. 3—Cleanliness of the machine leads to cleanliness of the operator and the surroundings

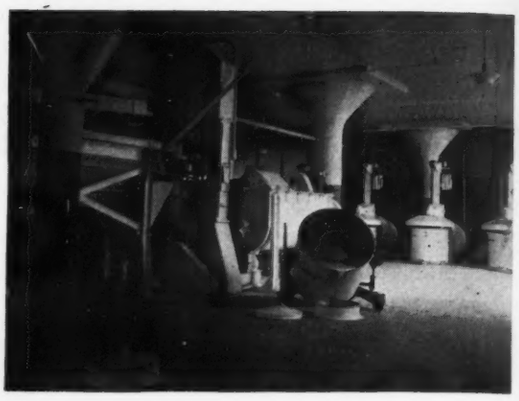


Fig. 4—White colors stress the cleanliness factor so important in the product

Another shoe manufacturer states that in the manufacture of women's shoes, cleanliness and color on the machines is even more important in controlling rejections and unit costs, than in the foregoing instances (both being in factories devoted wholly to men's shoes). The fine and more fragile fabrics and leathers used must be more carefully handled and color decreases the soilage and spoilage.

Color Brings Better Work

One machinery manufacturer changed from a gray to a bright red insulating paint on the castings that form a milling machine body. Comparisons of rough cutting and finishing operations showed the operators were doing better work after the color change was made.

Of course color is no Utopian aid. If the food industry finds not only white walls but white machinery a necessary asset, it does not follow that every foundry and all foundry machinery can be pastels. On the contrary, there are many divisions of industry where a too obvious use of color would be a mistake.

Color cannot be considered for machinery solely in terms of the usual things that a color implies. Green and blue are cool colors, but the intended location of the tool in the plant of the user has a large bearing on proper color selection. Green might be a fine color for a lathe to be installed in a well lighted interior. In a dark spot where all light is artificial and of low candle power the worker might be much more benefited by an orange machine. Laundries are hot places and blue is usually a good

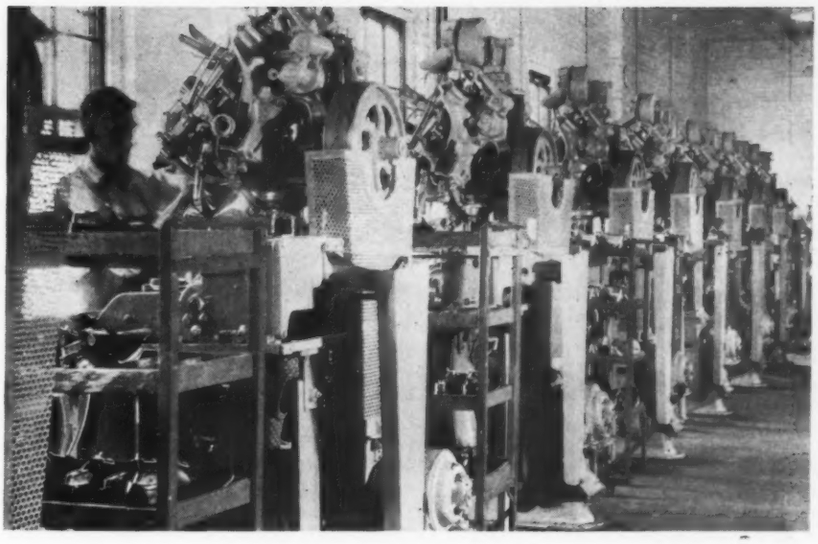


Fig. 5—Application of light colors to machines has proved that any leakage of oil will be cleaned more quickly than on drabber machinery

color for ironing equipment. If, however, the washing equipment is to be placed in a dark basement, a bright color on the surface of centrifuges and washers will be of greater value than a cool color, even though the surroundings be hot. Actual commercial uses have proved these points.

Inspection machinery should always be given color consideration. One purchaser, a manufacturer of hard rubber parts, mainly black, felt the best contrast would be a bright yellow and would show up flaws more vividly under visual inspection. It did, but it also showed that the color was too bright for the inspector's visual comfort and soon produced a nervous strain. Starting with white, blue was added until a tint was reached that was still very light, but had its brightness dulled. The compromise gave both a good contrast and a surface that aided the optical nerves of the operator.

Color Advancing Steadily

Machinery manufacturers may take a leaf from the book of experience of the auto industry. Each year sees a further advance into color. This year the color choice finds maroon, green and blue ahead of the standard black. In the New York Auto Show there was not a black car shown, even the aristocrats appearing in colored array. Color will lend interest, and once color has a wider introduction it will be employed permanently.

Fig. 6—Blueprint blue and gray color combination is ideal for design department

When we consider the application of color on machinery we are faced with the fundamental fact that one standardized color that can be applied and forgotten has sound production economies. So sound, in fact, that "machine tool gray" owes its birth and life almost wholly to this factor. Industrial machines are not turned out like automobiles, and painting facilities cannot be nearly so complete. On the other hand, a fair amount of study of the painting problem will usually show some ingenious method that eliminates a premium for painting.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Overcoming Sales Resistance by Color Effects and Finishes," by William J. Miskella, March, 1930, p. 15.

"New Use of Chromium Plating," April, 1930, p. 21.

"Evolution in Finishing Processes Worthy of Designer's Study," by M. J. Callahan, May, 1930, p. 46.

"Effecting Economies in Finishes," by William J. Miskella, Nov., 1930, p. 41.

"Specify Proper Finish and Color for Your Product," by T. J. Maloney, Jan., 1931, p. 33.

"Considering Machine Finishes from the Sales Standpoint," by William J. Miskella, May, 1931 p. 41.

"Improving Design with New Finishes," by William J. Miskella, Oct., 1932, p. 37.

"Porcelain Affords Protective Coating," Nov., 1932, p. 23.

"Sprayed Metal Offers Possibilities," Dec., 1932, p. 21.

"Supplementing Mechanical Efficiency with Good Appearance," by Walter Dorwin Teague, Dec., 1932, p. 22.

"Is it Possible to Standardize Machine Finishes?," Dec., 1931, p. 22.

"Metallic Coatings Combat Corrosion and Provide Attractive Finish," by Gustaf Soderberg, April, 1933, p. 18.

"Designer Should Specify Type of Machine Finish," by R. E. W. Harrison, Sept., 1933, p. 23.

"Consider Finish During Design to Reduce Costs," by S. P. Wilson, Oct., 1933, p. 31.

"We are constantly approaching a time when everyone can enjoy a standard of living equivalent to an income of $10,000 per year by working four hours per day for four days per week under proper organization. This will come, however, through the laboratory work by scientists rather than through legislative work by radicals."—Roger W. Babson.

Stoker Efficiency Enhanced by Design Changes

By Allen F. Clark
Associate Editor, Machine Design

THERE are many routes design may take in achieving the performance characteristics best suited for the work the machine must produce. In some few cases the best fundamental idea is the result of the first efforts of the designer, some machines are perfected by a series of improvements that bring them to ultimate perfection, while in other instances a radical change must be made from the basic ideas employed before the machine will perform its functions in a manner best suited to the work.

For years design effort in the industrial stoker field has been directed towards the production of a unit which will maintain a fuel bed of even thickness, protect the parts of the stoker by keeping them covered (thus obviating their burning out), achieve complete combustion of fuel and air, and eliminate troublesome clinkers in the fuel bed. Each of these problems has been solved to a degree by earlier forms of stokers, some designs conquering one or two of them, but they all were not surmounted until the fundamental designs in stokers were radically revised.

This revision, as exemplified by the Stowe stoker, *Fig.* 3, manufactured by Johnston & Jennings Co., is based on the chain grate principle, but is greatly modified to eliminate some of the difficulties generally encountered with this type.

The leading requirement for best operation, that of maintaining a completely uniform thickness of fuel and thus eliminating bare spots on the stoker surface, is met by slowing down the progress of the fuel from the front to the rear of the unit. In the stoker, stationary grate surfaces are alternated with moving grates, *Fig.* 1. These stationary surfaces oppose the forwarding efforts of moving chains to accomplish ideal fuel bed progression—fast at the feeding end but slower and slower toward the discharge end to compensate for fuel burned away and maintain a compact fire to the very end of the grate.

Housing Retards Ashes

At the rear end of the stoker there is an ash-retarding stationary housing. The entire fuel bed must be in compression before ash can be pushed across this final ash retarding surface. If one portion of the fuel bed should burn more quickly than the average and thus expose a sur-

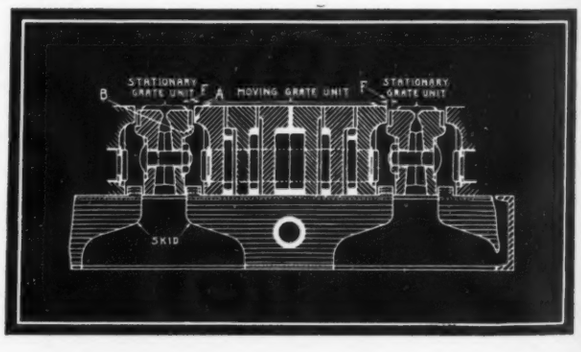


Fig. 1—*Stationary grate surfaces are alternated with moving surfaces to provide a fuel bed of even depth*

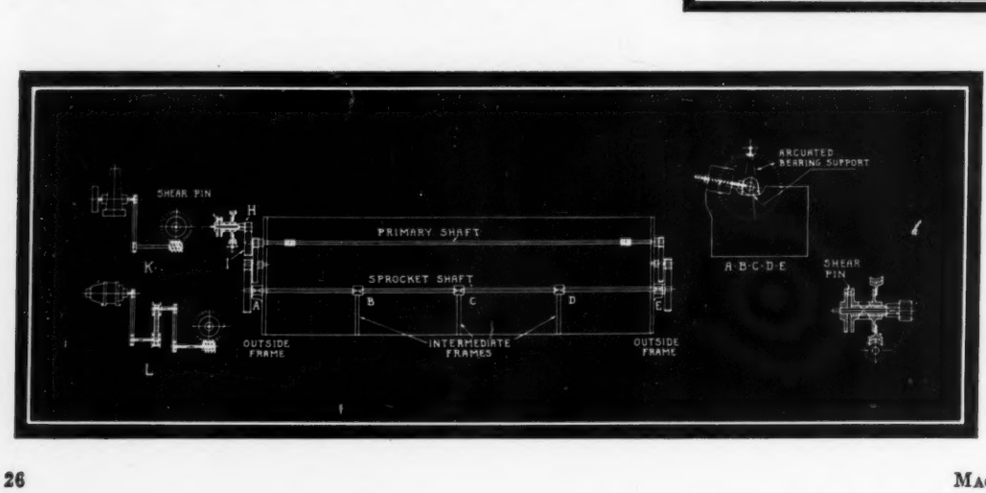


Fig. 2—*Drive shaft receives its power from both ends in design planned to minimize torsional strains*

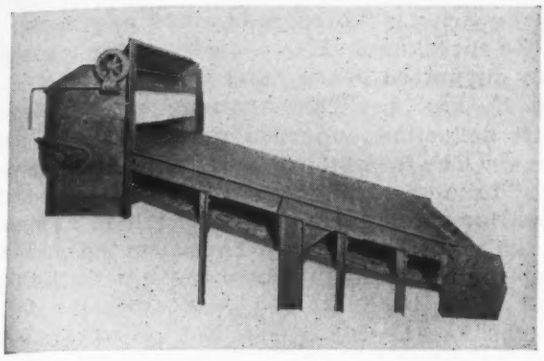
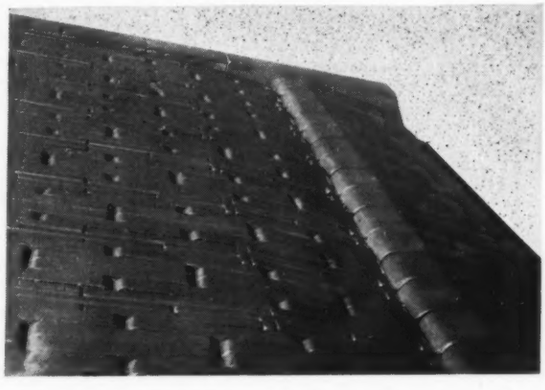


Fig. 3—Stoker developed for improved performance operates on chain principle

Fig. 4—Cover grates retain the air insuring more nearly perfect combustion



face of the grates, the fuel must be moved forward from the intake end before that toward the ash end will be moved out. In this manner the open area will be quickly covered. This method of keeping the compressing influence the same throughout the entire length of stoker keeps the coal everywhere collected together in a fuel bed of constant thickness and permits full wind-box pressure to the end of the fire.

Complete Combustion Necessary

For most economical operation, complete combustion of the air is equally as important as complete fuel combustion. Older designs were particularly concerned with this point. Water backs intended to confine the air between a suspended frame and the fuel bed were employed, and many methods of suspending a frame over the fuel bed were attempted. However, considerable air went up the stack in an unburned condition in almost every instance. In the design under consideration the air seal is not pierced by any moving parts. It consists of short heavy lower cast iron bridge plates that are bolted to the side and intermediate stoker frames; segmental cast iron shields for protecting these lower plates; and narrow, heavy, fuel-retarding cover grates that form the last 16 inches of active grate surface, *Fig.* 4.

But the design problems necessary of solution do not stop with the achievement of best combustion characteristics. The modern forced-draft stoker is an extremely heavy machine as it rightfully should be. This means a structural problem to devise means of supporting the weight and it means a mechanical problem to drive the moving parts.

Due to the fact that the Stowe stoker is made up of a series of moving chains alternating with stationary grates, intermediate center frames are made possible. These frames rest solidly on the foundations of the boiler house and each carries its full portion of the weight of the stoker. They provide supports for the rear idler assemblies at approximately every five feet and are a contributing factor in eliminating rear end troubles. They also provide fully supported and lubricated bearings at frequent intervals for the front driving shaft.

Other structural advantages are achieved, but perhaps the greatest asset from a mechanical standpoint is the distribution of the strains of tension and drive through several frames rather than concentrating these strains on the two outer frames. The strain on each take-up bolt is also minimized to make the tension easy of adjustment. The adequacy of this design can be shown when it is realized that the usual rather long stoker requires a drive shaft of 11 inches diameter while this design needs a shaft of only 3-15/16 inches for the same service.

Strain on the driving shaft is further minimized by dividing the torque developed. The primary shaft, *Fig.* 2, extends across the width of the stoker to connect up with a chain of spur gears that are a duplicate of those on the motor side. This equally divides the drive torque between the

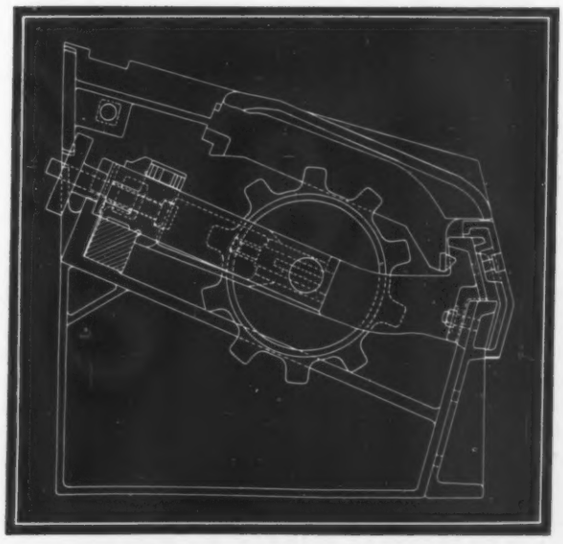


Fig. 5—Individual chain adjustment mechanisms aid in maintaining the proper chain tension

two ends of the sprocket shaft and reduces by one-half the maximum applied torque.

To permit the use of fuels which may burn at any rate of speed, a mechanical variable speed transmission has been incorporated as a part of the drive. This transmission is driven from the motor by V-belts and through V-belts drives the worm gear reduction unit, *Fig.* 6.

This worm reduction unit is especially built to accommodate a shear pin which protects the stoker from harm and provides an unlocking device for the worm gears so that the stoker may be hand operated and rotated in either direction as a convenience in assembling the stoker, etc. Such care has been taken in the design that it is possible to use No. 8 annealed copper wire for this shear pin.

Spur Gears Necessary

In all proper applications of work drive the bearing pressures at the pitch line are quite light. Horsepower is transmitted by reason of speed rather than of bearing pressure. However, worm gearing is not suitable for the remainder of the speed reduction, for while the total power required to drive the largest size of these stokers is under three horsepower, still the extremely slow speed of the sprocket shaft imposes a high tooth pressure on the bull gear and pinion. Proper design dictates that for this service spur gears must be employed. In the stoker being discussed, the gear shaft of the worm reduction unit is fitted with a cut steel pinion as shown at *H* in*Fig.* 2. This pinion with its gear *I* begins the reduction of speed through spur gearing. Three reductions are made.

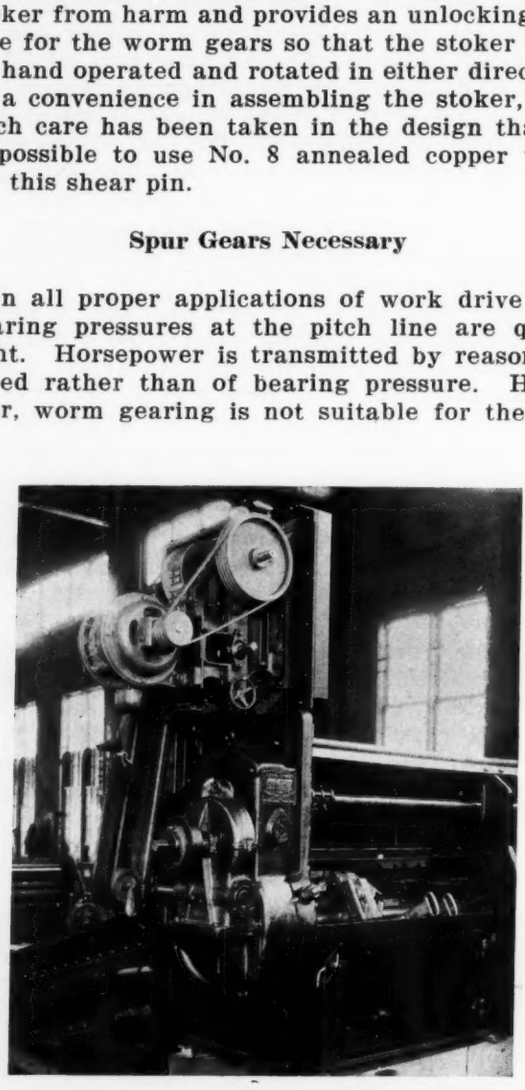


Fig. 6—A variable speed transmission and V-belts are combined with worm gear reduction

The sprocket shaft of a 20-foot stoker has five fully supported bearings as shown at *A, B, C, D* and *E, Fig.* 2. This arrangement eliminates shaft deflection and reduces the bearing pressures. The combination of spur gearing and front take-up is made possible by arcuated supports for the sprocket shaft bearings as shown at the right of *Fig.* 2. The arcuated supports keep the bull gear in proper mesh with the driving pinion at all positions of sprocket shaft adjustment. All sprocket shaft bearings are bronze bushings enclosed in a cast iron outer casing fully supported by the intermediate frames. Lubrication is attained by a high speed pressure system applied to the necessary points.

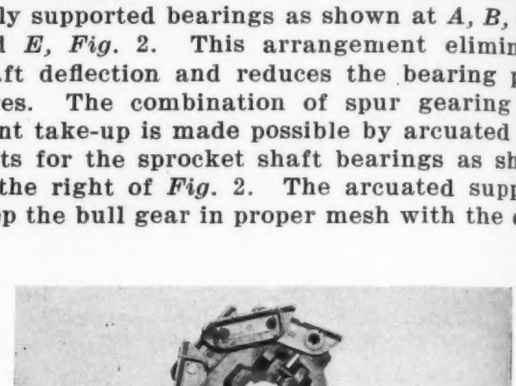


Fig. 7—Cast iron chain links are designed so that heat will be dissipated readily

Material Growth Is Large

The expansion of large stokers can be measured in inches, both lengthwise and widthwise. Provision must be made not only for this expansion but to insure that all parts will return to their original position upon contraction. In addition to this expansion and contraction, which deserves unusual attention with preheated air, there is the growth of parts to provide against. Inasmuch as the grates are subjected to much higher temperatures than their supports, provision must be made to insure complete freedom of wearing parts at all times. This provision is shown in *Fig.* 1. The moving chain links are provided with an overhanging ledge at *A* and the stationary bars with an underlying ledge or lip at *B*. The vertical distance between the lip and ledge is identical with the standard air space at all other parts of the stoker, and is not closed up or altered with expansion or contraction.

Lengthwise expansion of the stationary grates is accommodated by allowing them to extend

farther under the covers at the rear of the unit. The movable sections, however, cannot be accommodated in this manner. After some months of usage, any type of chain grate may have a difference of 8 or 9 inches in the length of one complete circuit of chin. The links adjacent to the side walls are but little affected by the growth of the iron while it is quite pronounced toward the center of the stoker. Another circumstance that makes unequal length of chain is the replacement of old with new parts. Thus, in time, unless the design provides a comprehensive method of adjustment the entire drive will be concentrated on the shortest circuit.

Individual Take-Up Developed

The Stowe stoker provides the usual universal tension adjustment through the front driving sprocket shaft by means of tension bolts carried at the intermediate and side frames. In addition. there is an individual take-up for each strand of chain, *Fig.* 5, located at the rear of the unit. With these individual adjustments, each chain is adjusted to exactly the same tautness and all slack is removed.

Chain links of the stoker are of cast iron. This metal, used for a great many of the parts, is especially developed for high tensile strength and high heat resistance, the minimum permissible tensile strength for the material being 35,000 pounds per square inch. Chain links, *Fig.* 7, are designed for efficient dissipation of heat. Link replacement was given especial consideration. Short links permit easy renewal as compared with designs where long rods had to be removed before links could be changed.

Cast Iron Widely Used

The same cast iron is used for the skids over which the chains slide. These cast iron parts are provided with upwardly projecting prongs that space the moving and stationary parts across the width of the stoker, *Fig.* 1. Due to the spacing lugs carried on the grid bars every grate part is kept equidistant and properly spaced across the width of the stoker under all conditions of expansion and contraction.

The complete redesign presented in this article not only gave improved performance characteristics, but it also increased the possibilities of completely automatic operation. It has been possible to reduce the adjustments necessary on each tuyere from around 16, the usual number, to one. Further, the variable speed drive lends itself to automatic control to secure the exact characteristics desired.

Throughout the design the facility of assembly was carefully considered. With such ease of assembly, it was possible to reduce considerably the required set-up and consequently reduce the cost to the manufacturer.

They Say—

"As more is known of the nature of residual stresses, mechanical peening (of welded joints) will offer a compromise solution which will enable the full possibilities of welded construction to be realized by the designer."—Everett Chapman.

□ □ □

"In the fight between the big, bad wolf and 125,000,000 capable and energetic people in the most richly endowed country in the world, who would bet on the wolf?"—Arthur D. Little.

□ □ □

"With labor costs somewhat standardized, prices must necessarily tend to become more uniform. Margins of profit, therefore, will depend more than ever before on operating efficiency. Earnings must be found by eliminating waste and increasing the productivity of workmen. This involves the better utilization of machinery and equipment. It will necessitate the replacement of obsolete or inefficient machines by machines adapted to modern, smoothly-functioning production methods."—Philip E. Bliss.

□ □ □

"In a rapidly moving age such as ours, most economic prophecies should be taken with a grain of salt and most economic prophets looked on with some suspicion. If the engineer is to venture into the troubled waters of today's economic problems with the idea of applying his well-tried scientific methods, he should take thought also of the measure and limitations of these methods, as otherwise he may bring discredit not only upon himself but upon the group he represents."—Dexter S. Kimball, dean of engineering, Cornell university.

Employment Reaches New High

EMPLOYMENT statistics, indicative of the business trend, present a more encouraging outlook. Chevrolet Motor Co. announces that it has achieved a new all-time high in employment for the week ending Feb. 10. Company payrolls totaled 56,545 people. The high mark prior to this year was 52,847 men and women employed in June, 1929. Plants are headed toward capacity, the report states. At Saginaw, Mich., where Chevrolet operates the largest gray iron foundry in the world, two daily shifts consisting of 4,660 men are pouring castings for new models, as against 3,443 in February 1933. Toledo, where transmissions are manufactured, had 2,571 men at work, within one man of the 1929 high.

It Will Pay To Give Operators More Design Attention!

By L. E. Jermy
Editor, Machine Design

IT IS questionable whether there ever before has been a period when so much stress was laid on the desirability for improving working conditions. Thinking is changing due to the pressure of the times. Indicative of this, from a general sense, are the acceptance of administrative measures such as N.R.A., C.W.A., etc., and the educational meetings that are being held throughout the country. The trend is definite, and cannot fail to have its affect on the design of machinery from the operator's standpoint.

In the past, consideration of the operator has been almost wholly a matter of getting the utmost out of him in efficiency. It does not speak well for the designer of a machine, however, to seek that efficiency at the expense of the operator's strength. A case in point is a machine designed some time ago in which the actual "endurance" of the workman was the measure of the productive capacity of the machine! Granted that certain types of physique are desirable in operating different classes of machines, it seems medieval to demand that physical endurance be counted on to obtain the desired output.

Fortunately the tendency in more recent designs has been to eliminate the necessity for brute strength on the part of the workman, so much so that many machines still in operation are apt to be condemned as obsolete

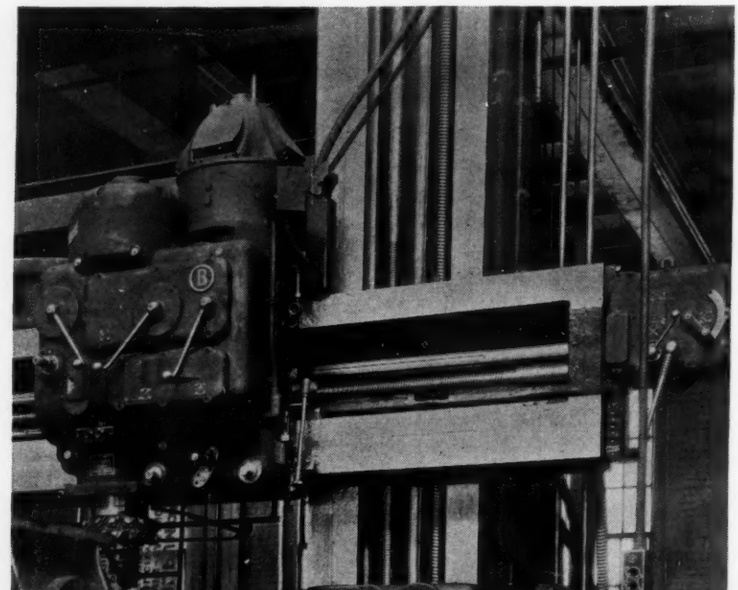


Fig. 1—(Above)—Levers are concentrated and heads motor operated. Note push button stations

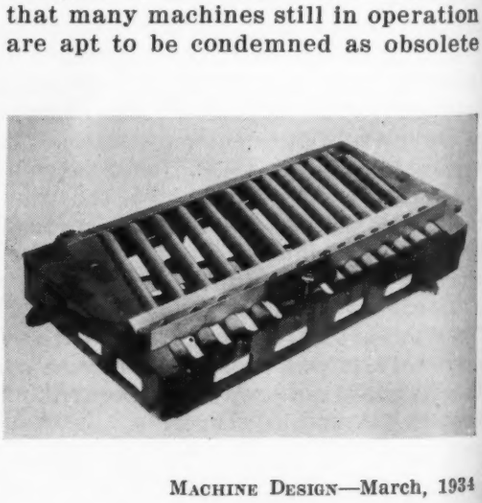
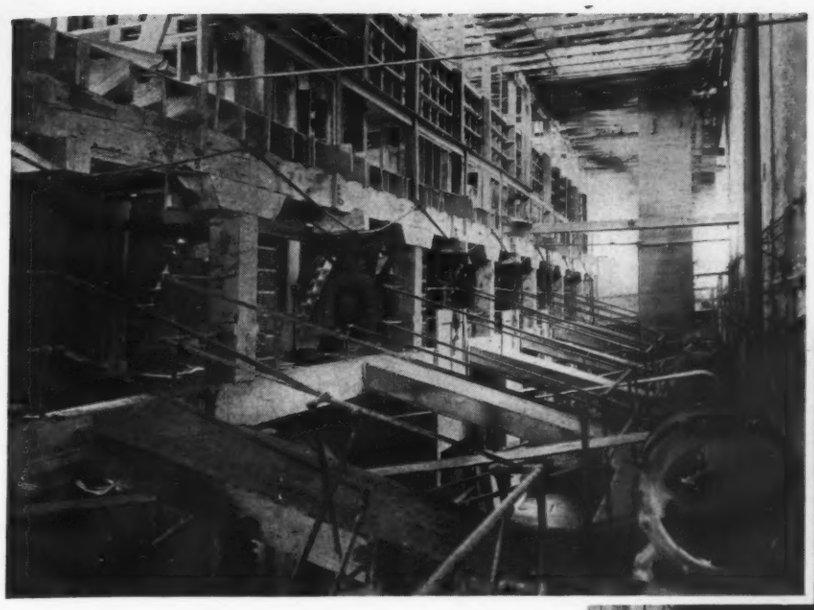


Fig. 2—(Right)—Magnesium casting is used for carrier frame so that it can be lifted readily



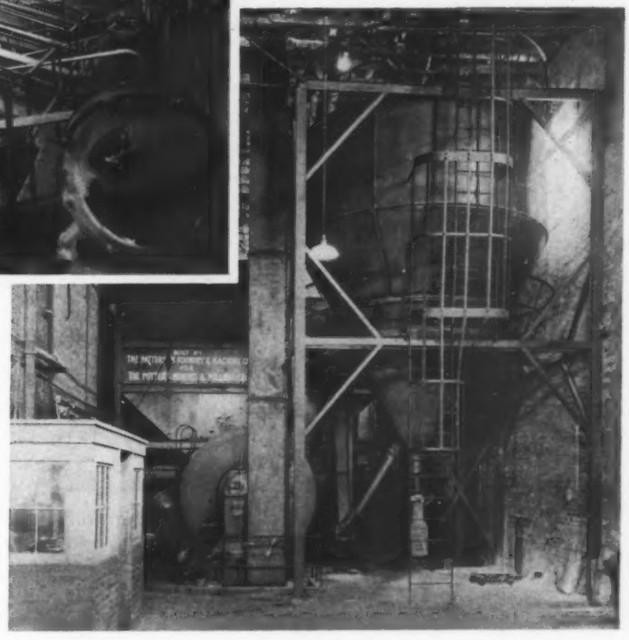


Fig. 3—(Left)—Many operators in this plant contracted silicosis due to silica dust from ball mills in lower left. Fig. 4—(Below)—Redesigned machine is sealed against escape of dust

if business conditions continue to improve. And the machines which will replace those discarded unquestionably will be of the type that embody in their design the maximum number of features calculated not only to increase the efficiency of the operator but also to safeguard him against injury, sickness or exhaustion.

Operating Convenience Is Recognized

Although the present nationwide conditions are focusing attention on this subject, many machinery manufacturing companies have given it consideration for some time. In machine tools for example, strenuous efforts have been made to centralize controls, provide individually motorized heads and in general to make the units more convenient and easy to operate. *Fig.* 1 illustrates such a machine, built by William Sellers & Co. Inc., Philadelphia. In the past, large planer-type milling machines were made with clumsy operating levers placed at the side of the machine. When moving the heads or table in setting up work, one man was required on top of the table and another handling the levers, the former signalling him as to how much to move the cutters.

Operating levers on this type of machine have since been placed exactly where they are needed. Each head carries its own electric motor and push button station and its own selection lever for vertical or horizontal traverse. Hand adjustment also is provided, and micrometer dials on the heads indicate the amount of movement. In setting up work the operator goes directly to the head and is able to operate it in sight of the cutter until it is in correct position for the next cut. The clamping mechanisms for the heads also are operated electrically.

Another aspect of ease in operation that is receiving the attention of designers is exemplified by the use of a magnesium casting for the removal cross carrier or slide of a machine built by Cleveland Folding Machine Co., *Fig.* 2. Employment of the light metal casting for the frame of this slide reduced the weight of the entire assembled unit to about 65 per cent of its former weight, enabling the operator to remove or place it in the machine with comparative ease.

Disassembly of Unit Aids Mounting

Similarly with the universal milling head developed by Kempsmith Mfg. Co., Milwaukee, aluminum being used in this case for the frame and several other parts of the unit. Not only has the weight of the head been reduced for ease in handling, but the unit is so designed that it readily may be disassembled into three sections for mounting by loosening screws in the quick-acting clamps that join the sections.

In the field of internal combustion engines some of the practices that were distinctly dangerous are being eliminated. Before the introduction of starting aids for diesel engines. for

example, such as the insulated and heated battery or the glow heater placed in the air intake, operators used the expedient of turning a gasoline blow torch into the intake manifold or of soaking rags in oil, wrapping them around the intake screen and setting them alight before attempting to start. Serious consequences often

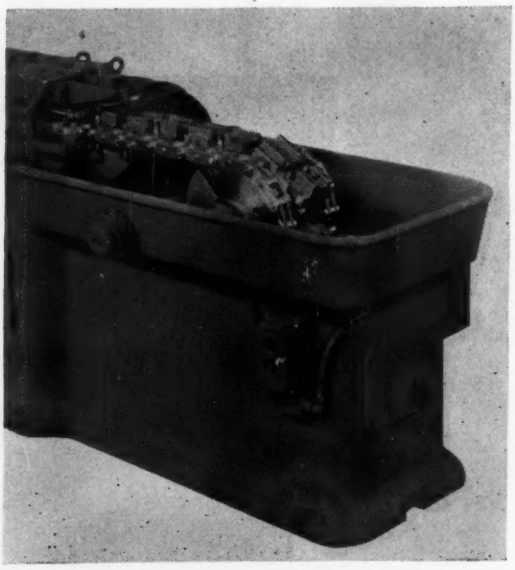


Fig. 5—Plugging switch is provided at operator's station for use if necessary

have resulted, and it is natural that one of the diesel designer's aims is the provision of safer and more efficient means for starting.

Occupational diseases contracted through operation of machinery may appear as a blot on the record of designers except for the fact that before the advent of machines these diseases were equally or even more rampant. Furthermore, efforts have been directed during recent years toward more adequate protection of the operator from this standpoint. Silicosis, for instance, that dread disease caused by constant contact with silicates, can be practically stricken from the list of occupational diseases. This can be accounted for largely by the elimination of dust from the atmosphere around the machines by which the silicates are handled.

Dust Allowed To Sift

A pertinent example of such a case is shown *Figs.* 3 and 4. The battery of machines shown at the lower left of *Fig.* 3 was built for pulverizing ground silica rock, received at the plant in the form of glass sand or, in other words, silica rock crushed to the size of sand. After the pulverizing operation in the mills the tight doors of the units were changed to slotted openings and the mills were again revolved while the material was discharged by sifting through these grated doors. Considerable dust arose during this operation, much of it floating above the rafters of the building and on to timbers, lineshafts, pulleys and belting which kept it constantly in circulation. Every man in the plant was forced to use a respirator from the time he entered the plant in the morning until he left in the evening. A high percentage of employes contracted silicosis.

Sand Seals Are Provided

All this has been eliminated by replacing the former batch mills by the unit shown in *Fig.* 4, developed by Patterson Foundry & Machine Co., East Liverpool, Ohio. This continuous feed and discharge ball mill is lined with silex and operates in a closed circuit. The mill is fed directly from a storage bin and the finished product discharges directly into freight cars. Sand seals are provided at the feed and discharge ends of the mill and being airtight there is no escape of dust, even though extremely fine, in the plant.

Design of foundry machinery also shows considerable improvement through the introduction of features for protecting the health of opera-

Fig. 6—Two-hand control of press practically eliminates possibility of accidents

tors. The enclosing of sand mill equipment to eliminate dust is a typical instance. National Engineering Co., Chicago, is building its mills with hoods of black sheet iron riveted and welded to a light structural frame. Dust is carried off through large pipes at the top of the hoods, thence by suction fan to a dust collector.

Similar methods to those discussed in the foregoing are being increasingly adopted throughout the machinery building field. Woodworking machines, for example, now are equipped with sawdust ducts for conveying fine wood particles away from the machine. One manufacturer, Oliver Machinery Co., not only builds

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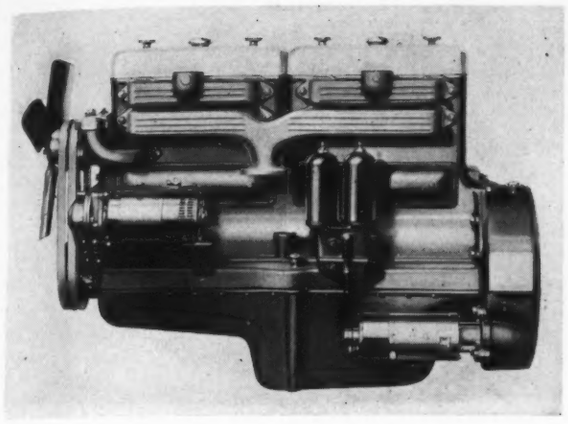


Fig. 1—Double shell lubricating oil filter is employed in one type diesel engine

Diesel Progress Leads To Wider Use

By Max Hofmann

Diesel Engineer, Waukesha Motors Co.

NO OTHER factor has contributed more to the rapid development of automotive oil engines in the United States than the economic depression of recent years. The large economies possible with this prime mover when compared with the conventional gasoline engine could no longer be ignored by manufacturers of automotive equipment. It is for this reason that during the last two years we have witnessed the application of automotive oil engines to buses, trucks, tractors, portable compressors, road building machinery, etc.

If we except the passenger car industry, it can be said that practically every motor manufacturer in this country who, a few years ago, built only gasoline engines, now has one or more types of oil engines available for the market, or else is working on the development of such engines. The main reason the passenger car industry is not so much interested in this new development is because the increase in manufacturing cost would be higher than the possible saving in fuel expenses during the life of the average car.

There are at present two fundamentally different types of automotive oil engines being manufactured. The first is the compression ignition or diesel engine in which the compression, and with it the temperature of the air drawn into the engine cylinder, is high enough to ignite the fuel charge promptly. This type is characterized by the absence of the ignition system conventional with other internal combustion engines. The other type is the fuel injection-spark ignition engine which, although less known, has become an important factor in the automotive engine market. In this type the air charge is compressed only slightly higher than in a conventional gasoline engine; the fuel charge is injected during the compression stroke and ignited by an electric spark as in the gasoline engine.

Without going into detail about the relative advantages and disadvantages of the two types, a short summary of these compared with the gasoline engine is in order to present a clear picture of the present situation.

Diesel engine advantages: Low fuel consumption, (about 60-70 per cent of the volume needed by a similar gasoline engine in variable load operation); low fuel cost, (about one-half that of gasoline, although this differential varies greatly with location); absence of electric ignition system; better torque characteristics, this meaning greater lugging ability at reduced engine speed; and reduced fire hazard of fuel oil.

The disadvantages are: Higher first cost; high compression and explosion pressures requiring sturdier construction, and resulting in a 20-30 per cent higher engine weight per horsepower;

DIESEL engine design has been advancing rapidly under the impetus of depressed business conditions which are conducive to opportunities of reducing operating costs. At present the majority of designs are based on those conceived in Europe where oil engines are much more widely used. Articles on the more intimate details of design will be given in future issues.

automotive diesel combustion results in a somewhat noisier engine operation; and diesel engines are harder to start than gasoline engines, and require more expensive starting equipment.

Fuel injection-spark ignition engine advantages: Low fuel consumption; (somewhat higher than diesel engine, about 75-80 per cent of the volume required by a similar gasoline engine in variable load operation); low fuel cost; better torque characteristics; and reduced fire hazard.

Its disadvantages include: Higher first cost, although this is less than that of a diesel engine mainly due to lower operating pressures and consequently lower engine weight.

Comparing the diesel and the low compression oil engine, it can be said that the diesel has a somewhat better fuel consumption, and does not need an electric ignition system. However, the low pressure oil engine can be built at a lower weight per horsepower, meaning a lower cost. Also, its wear and tear is less due to lower operating pressures. Although it needs a small quantity of gasoline for starting, it can be started by hand as easily as a gasoline engine, and it is capable of burning a wider range of fuels than the average automotive diesel engine with greater combustion smoothness. The torque curve on both engines is alike. Both engine types are yet too much in their infancy to permit conclusions as to which of the two is better suited for automotive requirements. All this depends to a large extent on the type of installation it is going to serve.

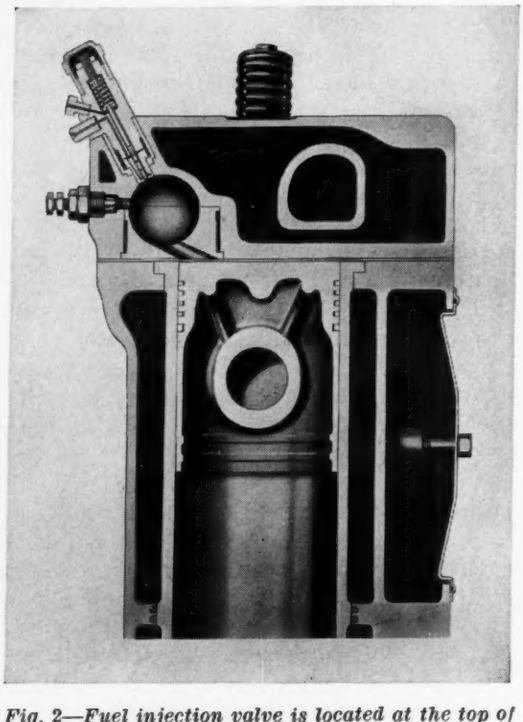


Fig. 2—Fuel injection valve is located at the top of the combustion chamber

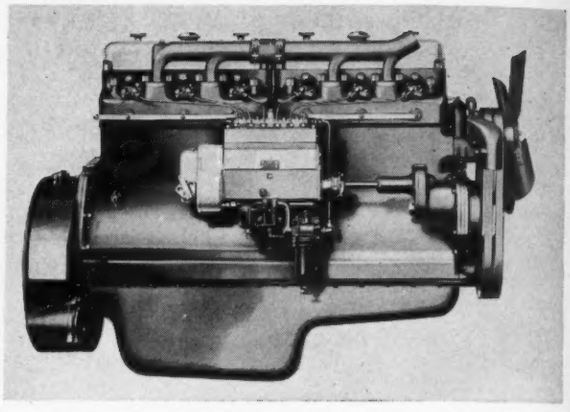


Fig. 3—Governor controlling both idling and maximum speed is built onto the engine

Fig. 2 is a cross section through the cylinder of a Comet Diesel, as manufactured by Waukesha Motor Co., showing the combustion chamber design and the location of the fuel injection valve. The combustion chamber of this engine, based on the patents of H. R. Ricardo, English designer, is a sphere in the cylinder head with a venturi-shaped channel forming the connection between this chamber and the cylinder. This design provides a maximum of air turbulence necessary for the intimate mixing of air and fuel. In an engine running at 2000 revolutions per minute, the time available for the mixing and the combustion of the fuel and air is only about 1/300 of a second per cycle.

Fuel is injected into the cylinder by a hydraulically operated injection valve (on top of the chamber), *Fig.* 3, with a pressure of about 1500-2000 pounds per square inch, while the compres-

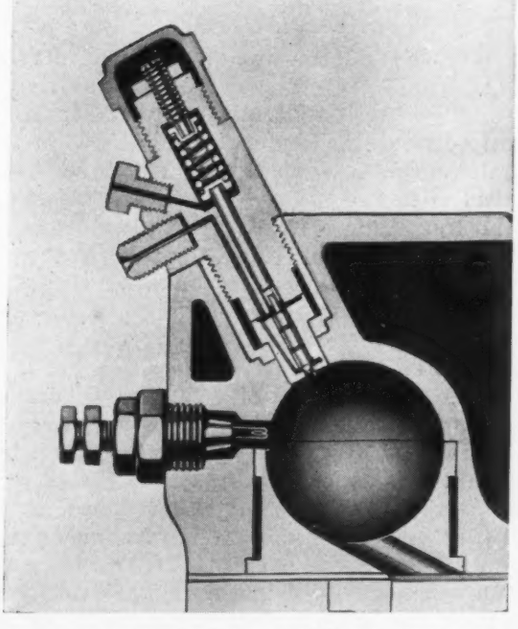


Fig. 4—Special glow plugs facilitate starting under possible handicaps

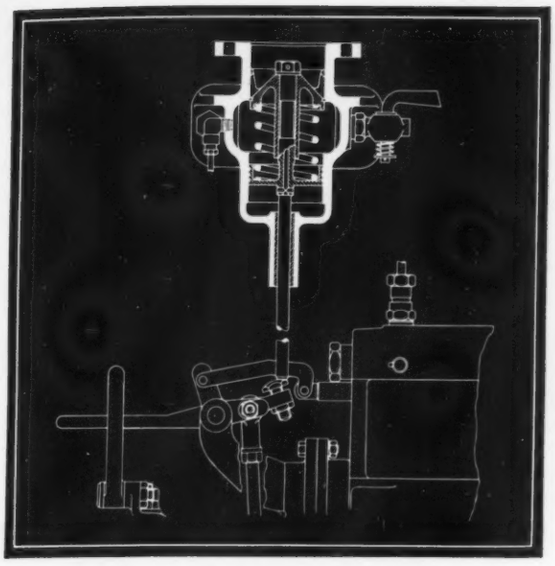


Fig. 5—Valve controls intake air flow between idling and half load in proportion to load

sion of the air charge in the cylinder is carried up to 550 pounds per square inch. This compression pressure generates enough heat to make the engine cold starting, except in subzero temperatures. To make the engine starting independent of outside temperatures, and to facilitate starting under all possible handicaps, special glow plugs lead horizontally into the combustion chamber. These plugs are connected with the starting system in such a way that they glow during the time the starter button is depressed.

Only the upper part of the combustion chamber is contained in the cylinder head while a special cup forms the lower half of the sphere and the channel, *Fig.* 4. Precautions were taken to reduce the area of contact of this cup with the watercooled surfaces of the cylinder head.

By keeping the temperature in this cup as high as possible, a much smoother engine operation can be obtained. On the other hand, this feature

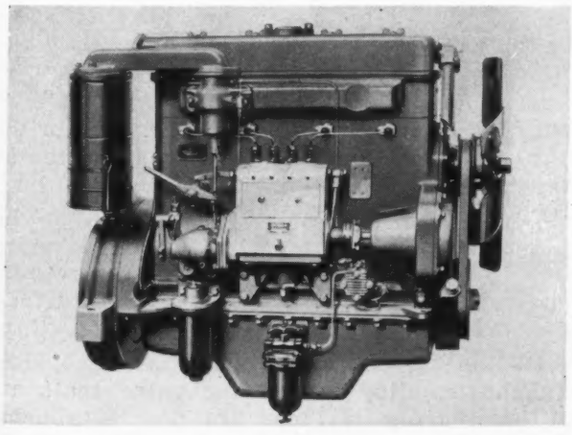


Fig. 6—Air drawn through the filter has to pass the air control valve

makes the engine less sensitive and permits the use of a wider range of fuels than the conventional high-speed diesel engine. In view of the high heat stresses to which this part is subjected, the selection of a suitable material presented some difficulty. A satisfactory solution of this problem was found by using an austenitic steel of similar characteristics to that used on exhaust valves of gasoline engines.

Fig. 1 is a view of the manifold side of a six-cylinder Comet Diesel engine, showing a double shell lubricating oil filter, and also the mounting of the electric starter and generator. The intake manifold consists of two separate halves, a feature which substantially improved the

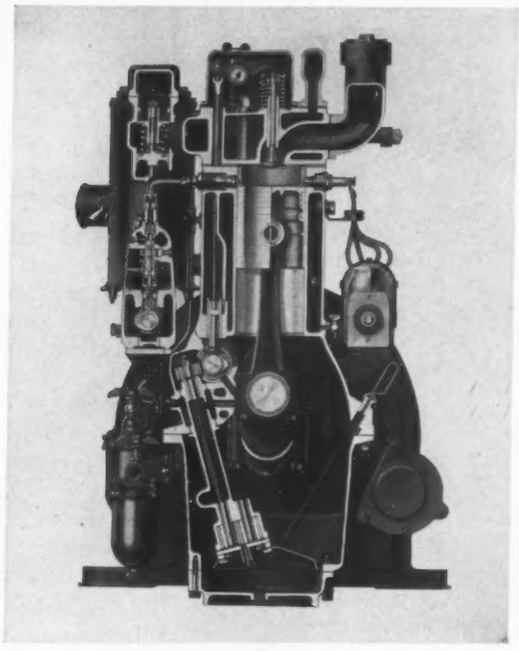


Fig. 7—Low pressure oil engine uses balanced type air control valve

volumetric efficiency of the engine.

Fig. 3 shows the fuel pump side of the Comet engine. The engine governor, controlling both idling and maximum engine speed, is built on to the left side of the fuel injection pump. The fuel injection valves, connected by seamless steel tubing to the fuel injection pump, can be seen mounted on the cylinder head in recesses between the top water manifold outlets.

Below the fuel injection pump is mounted a rotary fuel delivery pump which draws the fuel oil from the main tank. On its way to this pump the fuel has to pass a water and sediment trap combined with a primary filter.

From the rotary pump, the fuel is forced at a predetermined pressure through a second filter of fine mesh, and then into the suction side of the fuel injection pump. Careful filtering of the fuel is highly essential in all oil engines as it

(*Concluded on Page* 45)

MACHINE DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

Patents, Invention and Design Ingenuity Revitalized under New Deal

IT IS increasingly evident that the new deal is having its effect on design of machinery. One of the factors—possibly somewhat minor but nevertheless convincing—on which this statement is based is the renewed interest in invention and patents. Contributions that have appeared recently in MACHINE DESIGN on this subject have received widespread attention, and readers are evincing more interest in complete books on patents than on any other single subject.

Excellent reasons are forthcoming for this new design activity and interest in patent procedure. With industrial codes being put into general effect, competition will cease more and more to be a matter of cost comparison; it is likely to be based instead on the adaptation of improved machine parts and materials, and on originality and inventive skill in design.

Greater interest in patents is being fostered also by the improved relation between employer and employe. Designers who may have been reticent in coming into the open and assigning their patents to the employer feel more encouraged to do so under the new relations. This is exactly what management is looking for due to the desirability of their developing new machinery and of having patent protection on it.

Design ingenuity will pay the best dividends to those companies and engineers that are capably equipped to assist their patent attorneys in securing effective protection. One way to do this is to obtain as comprehensive a knowledge as possible of existing patent laws and procedure.

• • •

The Gap Narrows

DESIGNERS are becoming more and more "alloy conscious." At a recent meeting on casting developments at which authorities on steel, cast iron and malleable castings presented papers the attendance exceeded by far the average at technical meetings. A large proportion of those present comprised engineers in the design group.

Introduction of alloying elements into cast irons, steels and to a lesser extent malleable irons is accountable for the renewed attention being paid these materials. Physical properties are tending to draw closer together, with the result that selection of design materials is becoming increasingly difficult.

Cast iron for crankshafts, alloy inserts for valve seats and hard facing materials for wearing surfaces are now established facts. Can one afford to overlook the ever-changing utilization of materials and alloys?

MEN

and Their

MACHINES

E. E. Adams and His High Speed Streamlined Train

Men and their Machines

IMAGINATION . . . the word connotes a distinctive attribute in design. It is the force that impels all machinery progress. It is, specifically, the power that is transforming our long-antiquated railroad equipment into modern standards of speed and beauty. Consider for instance the achievement of E. E. Adams, one of the pioneers in bringing the new streamlined train into reality, whose portrait is depicted on the previous page with the new Union Pacific high speed train he has designed and which now is undergoing rail tests.

It is not surprising to learn that Mr. Adams is an outstanding exponent of the characteristic of imagination. He declares that if there is any particular formula or requirement that an engineer should follow to be successful it is the embodiment of this factor in his work. The inevitable result is the desire to do creative design rather than the regular routine of engineering.

In asserting this Adams speaks from experience. He has followed exactly that line of thought throughout his engineering career. Working his way through the University of California by aiding in laboratories gave him contact with many development projects that were in the experimental stage. There he obtained prima facie evidence of the essential mental power known as vision.

After graduation he became associated in 1905 with the Southern Pacific railroad. His tasks were particularly conducive to obtaining the broader aspects of the technical profession inasmuch as he was not confined to the routine of any one department. Consequently he acquired at this early stage of life the rudiments that were to play an important role in this present position and accomplishments.

Successively, Mr. Adams was mechanic assistant engineer and later assistant to the consulting engineer for Union Pacific and Southern Pacific lines. Upon dissolution of the two roads in 1913 he became consulting engineer for U. P. In September, 1929, a vice presidency was accorded him, and in February, 1933, he was assigned to conduct research and formulate ideas for improved railroad passenger equipment. On August 1, 1933, Mr. Adams was elected vice president of Pullman Inc.

A prolific reader of books and magazines, Mr. Adams supplements his study by aggressiveness. Habitually, he takes long walks, is an inveterate pipe and cigar smoker and never eats lunch.

Railway Equipment

PROFESSIONAL VIEWPOINTS

Machine Design Welcomes Letters Suitable for Publication

Study Operating Conditions!

To the Editor:

MAY I compliment you on your editorial in the February issue entitled "Survey of Operating Conditions Is Essential During Design." To better appreciate the need for a fuller understanding of the purchaser's wishes, a designer need only take a walk through his own shop. Here he will undoubtedly find many machines purchased from other manufacturers that have had numerous gadgets added to them. The workmen sees a method of providing easier operation, or simplified operation, so he puts a home-made device on the machine he is using to obtain the features he desires.

Of course, many improvements made by the men in the shop are not of the type that would be applicable to all machines being manufactured. However, there is a basic idea and a need for each of them. The best procedure would be for designers to observe the operation of their machines in the plants of their customers. Talk about the operation, and ask what the customer believes could be improved.

—L. A. JOHNSON,
Chicago

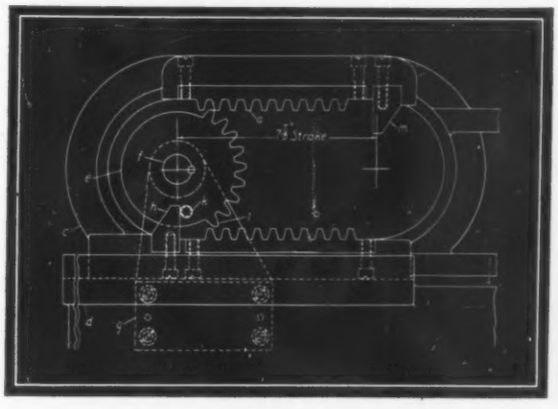
Securing Reciprocating Movements

To the Editor:

A MACHINE for lapping recoil cylinders of a small artillery gun is equipped with a rather ingenious mechanism for imparting the long reciprocating movement to the cylindrical lap in which other designers may be interested. This movement, shown herewith, is uniform during the entire cycle with exception that at each point of reversal the velocity momentarily varies. This variation, however, can be ignored because it is so slight that it does not affect the functioning of the machine.

Opposing racks *a* and *b* are secured by screws to slide *c* which travels in guides on machine frame *d*. Fastened to the right-hand end of the slide are three cylindrical laps (not shown) for lapping three cylinders simultaneously. Segment gear *e* is the driving member and is keyed on shaft *f* which rotates in a clockwise direction at a constant velocity in a bearing on stationary bracket *g*, bolted to the machine frame. Near one end of each rack is located reversing stops *h* and *m* both of which are securely fastened to slide *c*. These stops engage pin *k* in the segment gear at both points of reversal.

In the position indicated, the slide has just completed its movement toward the right and pin *k* has moved into contact with stop *h*. Since



Double rack and segment gear arrangement produces long reciprocating motion

the gear at this time is leaving rack *a*, further rotation of this gear will cause the pin to force stop *k* with the slide toward the right until the first tooth *l* is in complete engagement with rack *b*. Following this, pin *k* and stop *h* begin to recede from each other because the engaged tooth causes the stop to move faster than the pin.

As the gear continues its rotation the slide is carried at a uniform velocity to the end of its stroke. At this point the pin is in the same position relative to stop *m* as with stop *h* at the beginning of the stroke. Also the gear teeth are disengaged from rack *b*. Consequently the pin forces stop *m* with the slide toward the right thus reversing the movement of the slide. Tooth *l* then engages the first tooth space in the rack so that the gear picks up the movement and carries the slide to the end of its stroke to the right.

—J. E. FENNO,
Belleville, N. J.

TOPICS

LIBERTY aircraft engines now are history. The curtain fell on their career when an order was issued by the chief of the Army Air Corps prohibiting major overhauls of them. Designed by Col. J. C. Vincent and Col. E. J. Hall, the Liberty engine probably was the greatest American contribution to mechanical equipment used in the World war. Meeting for the first time, May 29, 1917, at the Willard hotel in Washington, these two well-known engineers set to work immediately on layout drawings for a new U. S. A. standardized line of aircraft engines. In six days they emerged with completed plans. The name "Liberty" was applied to the engine by Gen. Taylor at one of the meetings of the Aircraft Production board. The design formed the basis of future progress in aircraft engine development in this country.

* * *

Cause of Skin Cancer Among Workers Traced to Lubricating Oil

OF INTEREST to builders of machinery for the textile industry is a recent discussion from the *New York Times*. It concerns skin cancer, sometimes called mule spinner's cancer, among textile workers. The disease, reports *Science Service*, may be lessened by changing the quality of lubricating oil used on textile machinery, it appears from studies made by Dr. C. C. Twort and J. W. Twort of the Manchester Committee on Cancer. This type of cancer is due to the irritation of the skin by the constant soaking of one spot on clothing with oil as the worker bends over his machine.

The Manchester investigators state that the cancer-producing property of the mineral oil is related closely to its refractivity constant. This term, referring to the oil's ability to bend light waves, is used by physicists and chemists to indicate its type. Refined grades of oil employed on textile machinery have greater cancer-producing power than crude oil, the Tworts found. Treating oils with sulphur dioxide profoundly lowers their refractivity. The Manchester scientists suggest this treatment or careful selection of lubricating oils as a means of reducing the amount of cancer among textile workers.

* * *

First Standards in Electric Welding Field Are Approved by A. S. A.

FIRST national standards in the field of electric welding recently were approved by the American Standards association. These standards, covering the electrical apparatus for arc and resistance welding, are intended to assure an adequately and properly controlled supply of electric current to meet the exacting requirements of welding service. Generators, transformers and other equipment are covered by the standards. The sectional committee on electric welding apparatus was organized in 1931 under the joint sponsorship of the American Institute of Electrical Engineers and National Electrical manufacturers association.

* * *

Balls Substituted for Wheels on Russian Streamlined Train

SUBSTITUTING balls for wheels on streamlined trains, Nicholas Yarmochuk hopes to establish in Soviet Russia a new type of vehicle for transportation. Higher speed is the motive behind this unconventional idea. His train will not employ tracks but will run in a concrete trough of semicircular cross section. A huge steel ball at each end of a car rolls in the trough. This innovation is claimed to obviate the problems encountered when trains travel over rails at more than 75 miles an hour. It is declared

that with fast trains rails are difficult to hold in place; hence a trough.

Curves do not constitute an obstacle for this design; Yarmochuk holds that his cars will be able to take curves at a maximum of 200 miles per hour. Much discussion has been incited by the introduction of this idea . . . it will be interesting to watch its progress. Word of this radical departure from rail wheels shows at least that Russian engineers are thinking.

* * *

Mine Workers in Convention Voice Defense of Mechanization

A NEWSPAPER dispatch recently brought out that the United Mine Workers of America rose to the defense of the machine at their thirty-third constitutional convention at Indianapolis. The problem of mechanization as applied to the coal industry was introduced in a resolution urging the convention to adopt provisions for the gradual removal of machinery from the mines so that more human labor would be employed. The resolutions committee introduced a substitute measure suggesting that instead of urging curtailment of the use of machinery, the convention fight for a shorter day and a shorter work week.

* * *

Wants System of Classification For Industrial Lubricants

REQUEST has been made by the American Society of Mechanical Engineers that the American Standards association authorize the initiation of a project and the organization of a sectional committee to develop a system of classification of lubricants for industrial use based upon viscosity numbers. This request from the A.S.M.E. has resulted from consideration given to the problem at recent meetings of the petroleum division of the society. It is pointed out that viscosity should be considered as a dimension of the lubricant and not as an indication of quality.

Attention also is called to the advantages of a standard classification of industrial lubricants, indicating that machine designers and builders, industries and producers as well will be benefited through development of such a standard.

* * *

Paddle Type Airplane Shows Encouraging Results in Wind Tunnel Tests

PROMINENT among aviation gossip is the fact that negotiations are in progress for the construction under license in England of the Rohrbach type of paddle airplane. Both lift and thrust on this plane are derived from the operation of rotating wings set on either side of the fuselage after the fashion of paddle wheels on a steamboat. According to the *New York Times*, experiments along this line in the United States, France and Belgium have not yet led to the production of a full-sized aircraft, but smoke and wind tunnel tests at Langley Field, Va., have been most encouraging. It is proposed in England that a 240 horsepower engine shall be used and it is stated that, allowing a useful load of 600 pounds, such a machine would have a top speed of 124 miles per hour and a minimum air speed of 13 miles an hour. It also would be able to fly backward at a speed of 19 miles per hour in still air.

* * *

Outlines Results Obtained in Use Of Copper in Gray Cast Iron

FOUNDRY topics of the month to which more than usual attention has been directed, include the discussion on copper in gray cast iron. Valuable data has been brought to light by C. T. Eddy, Michigan College of Mining and Technology, writing in the February issue of *The Foundry*. Briefly, he outlines his findings as follows: Copper like silicon and nickel decreases the tendency of cast iron to chilling. It assists the decomposition of primary cementite or prevents its formation. This effect of assisting graphitization together with the change of the pearlite to sorbite or a higher form in the matrix and the strengthening of the ferrite because of dissolved copper results in a hard strong iron which because of the absence of free cementite possesses good machinability.

* * *

Exposition Reveals Unprecedented Interest in Air Conditioning

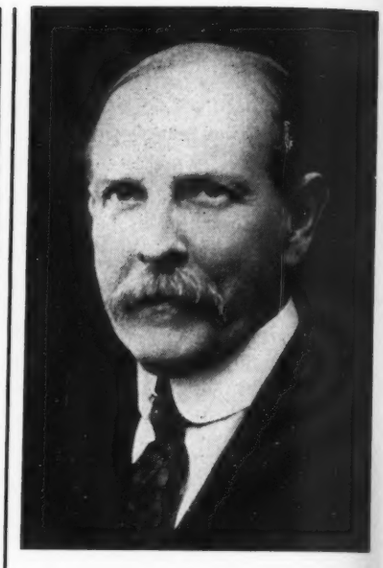
WITH 1000 engineers attending the annual convention of the American Society of Heating and Ventilating Engineers and 54,000 people at the exposition held simultaneously, conclusions are that developments in this field are numerous and noteworthy. Enthusiastic reports from New York bear out this fact. All phases of the industries involved were represented at the show. Various designs of heating, ventilating and air conditioning apparatus were exhibited. The growing importance of the latter as the basis of a rapidly expanding new business was evident to observers. Equipment on display included oil burners, coal stokers, fuelless hot water heaters, automatic controls, etc.

MEN OF MACHINES

FOR meritorious achievement in the electrical world, Dr. Arthur E. Kennelly has been awarded the Edison medal for 1933 by the American Institute of Electrical Engineers. His marked scientific ability, versatility in the application of complex theory to practical purposes, and continuous contributions to development of definitions and standards in electrical engineering have given him an outstanding international reputation. He is professor emeritus of electrical engineering, Harvard university.

Born near Bombay, India, on Dec. 17, 1861, Dr. Kennelly's early education was obtained in England, Scotland, France and Belgium. Coming to the United States in 1887, he was engaged as principal electrical assistant to Thomas A. Edison, until 1894. In 1902 he went to Harvard as professor. He served also as professor at M.I.T. (1913-24), and during the year 1921-22 represented seven American universities as first exchange professor in engineering and applied science at several French universities.

Dr. Kennelly has published about 28 books, ten of which he is sole author. He has prepared more than 350 technical papers. One of his chief contributions to applied science is a paper on "Impedance" presented in 1893 before the American Institute of Electrical Engineers.



A. E. KENNELLY

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WYMAN EATON

PROMPT, rapid promotion has been the reward for the outstanding technical and executive ability of Wyman Eaton who has recently been named president of Freyn Engineering Co., Chicago. Mr. Eaton became associated with the Freyn company in 1919 as chief engineer. Later he was made vice president and general manager and now has been awarded the chief executive position. During his service with the company he has designed or built blast furnaces and steel works in Russia, Siberia, England, South Africa and Australia as well as in the United States.

Following his graduation from Purdue University, Mr. Eaton became associated, in 1902, with Julian Kennedy, specializing on blast furnace and rolling mill design. After several years in this position, he went into the engineering department of Youngstown Sheet & Tube Co. Later he joined William Tod Co., steel mill equipment designers and builders at Youngstown, O. This organization is now a part of United Engineering and Foundry Co.

In 1915 Mr. Eaton became associated with Mesta Machine Co., and for four years was in charge of its rolling mill department. He is an active member of the American Iron and Steel institute and the American Society of Mechanical Engineers.

EXTENSIVE survey of marine operations of various departments of the New York City government recently completed by Eads Johnson bears witness to his prominence in the marine field. As a consulting naval architect and marine engineer one of his latest innovations is a unique all-welded craft, 65 feet long and capable of carrying 12 automobiles.

Youngest son of the founder of the Johnson Iron Works, Eads Johnson was born in New Orleans in 1878. After obtaining a degree in mechanical engineering from Tulane university in 1898 he went to Cornell for a postgraduate course in marine engineering and naval architecture. Succeeding years invested him with a wealth of experience and in 1910 he opened his own offices in New York.

His first important commission was the design of the tug INVINCIBLE, followed by a variety of other vessels including the first oil-burning tug in the New York harbor. For a period during the World war he had charge of 16 shipyards. In 1921 Mr. Johnson designed the first diesel-type ferry and shortly after he developed the first diesel electric ferries, as well as the first diesel electric freight boat and iron screw tunnel diesel towboat. He now is acting chairman of the Eastern division of ferryboat operators.

EADS JOHNSON

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C. HAROLD WILLS

FEW names on the roster of personalities associated with automobile building rank so high as that of C. Harold Wills who has joined the executive staff of Dodge Brothers Corp. His experience parallels automobile development from the first hand-built Ford to the advanced designs of the present day. Mr. Wills began as a machinist when he was 17, and by the time he was 21 he was regarded as an expert. One of his earliest executive jobs was that of chief engineer of Boyer Machine Co. of Detroit, now known as Burroughs Adding Machine Co.

Upon relinguishing this connection, Mr. Wills became associated with Henry Ford, at a time when the latter was building his first car. The success of that first car carried Mr. Wills to fame. He is credited with having designed every Ford from 1903 to 1919. More than that, he is given credit for having organized, as Ford's chief engineer, the quantity production methods which made possible the manufacture of a million cars in a year.

In the course of his metallurgical work Mr. Wills was instrumental in the development of vanadium steel and molybdenum steel, and during the World war he was called upon to aid in the production of the Liberty motor. Later he became identified with the design and manufacture of Wills Ste. Claire automobiles.

• • •

H. T. THOMAS, veteran head of the Reo Motor Car Co. engineering staff, will devote virtually all his time to the duties of chief research engineer. This announcement was made simultaneously with the appointment of RAY J. FITNESS as chief engineer of the organization.

* * *

DR. L. C. PAN, technical director of the U. S. Research Corp., New York, has been elected a fellow of the American Association for the Advancement of Science.

* * *

F. E. HARRELL has been made assistant chief engineer of the Reliance Electric & Engineering Co., Cleveland. His former position was that of

chief draftsman and engineer in charge of A-C design. He joined the Reliance organization upon graduation from Purdue university in 1924.

* * *

POPE YEATMAN, New York consulting mining engineer, has been awarded the William Lawrence Saunders gold medal for 1933. It was presented to him recently at the annual dinner of the American Mining and Metallurgical Engineers in New York.

* * *

H. B. MCLAUGHLIN, chief engineer of Liquid Cooler Corp., Detroit, is in charge of the new laboratory recently set up by the company to conduct tests on newly designed coolers and cooler parts.

* * *

JOHN F. COLEMAN recently was elected president of the American Engineering council. He is past president of the American Society of Civil Engineers.

* * *

D. J. MORAN, president of the Continental Oil Co. and E. O. BENNETT, chief engineer, are the inventors and patentees of the pumping unit discussed on page 19 of this issue. It has been named Rannett, an abstraction of their names.

* * *

HOWARD N. EAVENSON, Eavenson, Alford & Hicks, Pittsburgh consulting engineers, was elected presdent of the American Institute of Mining and Metallurgical Engineers at the recent meeting in New York.

* * *

LESLIE PEAT, until recently editor of *Automotive Idustries*, has been appointed editor of *Industrial Standardization and Commercial Standards Monthly*, published by the American Standards association. He succeeds ARTHUR KALLET who has resigned.

* * *

F. E. BASH, manager, technical department, Driver-Harris Co., has been elected to membership on the joint research committee which is studying effect of temperature on the properties of metals, under the joint auspices of the American Society for Testing Materials and American Society of Mechanical Engineers.

* * *

C. V. HAYNES of Philadelphia was elected president of the American Society of Heating and Ventilating Engineers at its recent annual session in New York. He succeeds W. T. JONES of Boston. JOHN HOWATT, Chicago, was made first vice president and G. L. LARSON, Madison, Wis., second vice president. D. S. BOYDEN, Boston, is treasurer and A. V. HUTCHINSON, secretary.

* * *

T. B. TERRY has been promoted to production manager of Gibson Electric Refrigerator Corp., Greenville, Mich. Before coming to Gibson he was connected with General Motors Corp. for 11 years, the first five of which were spent with General Motors Research Corp. as research engineer. At the Frigidaire Corp. his position included that of development engineer in charge of design of a commercial gas refrigeration unit.

Obituaries

JAMES HARTNESS, pioneer machine tool builder, designer and inventor, died recently at his home in Springfield, Vt. His retirement from the presidency of Jones & Lamson Machine Co. was announced in MACHINE DESIGN last June. Schenectady, N. Y., was his birthplace, Sept. 3, 1861.

Mr. Hartness' first experience in machine shops was gained in Cleveland. He became affiliated with the Jones & Lamson company in 1889 and was the first superintendent until 1893, manager until 1900 and president from then on. During this time he was one of the most influential designers of machine tools of his generation, owning over 100 patents on such units as a flat turret lathe, an automatic die, turret equatorial telescope, screw thread comparator, etc.

* * *

C. ROY WATSON, author of articles on the philosophy of inventions published in the *United States Patent Journal*, died recently in Detroit. He was associated with the late Henry Leland in the development of Cadillac cars and had been in charge of experimental activities of the Cadillac Motor Car Co. for many years.

It Pays to Give Operators More Design Attention!

(*Concluded from Page* 32)

these into his machine but also, as protection for the operator from the standpoint of injury, provides a mechanical brake for each of the electrically-driven cutter heads of his moulding machines.

Magnetic brakes also are utilized to advantage on rubber mills, these being particularly dangerous due to the tendency for the operators hands to be caught during the feeding of the rubber. A special switch bar is furnished on these machines that can be operated from practically any position or even by the operator's head if both hands should be caught.

One of the most recent examples of utilization of a safety switch is depicted in *Fig.* 5. This shows the operating end of an external broaching machine designed by Foote-Burt Co. The special plugging switch at the front of the unit to the left of the punch button station can be utilized for stopping the machine immediately if danger is imminent due to carelessness in loading the machine.

Employs Electronic Cell

In the design of presses, shears and similar machines, much remains to be accomplished from the standpoint of protection. The photo-electric cell is being utilized in some instances for stopping the machine if the operator's hands are in the danger zone, but practically all of these are cases in which the equipment is fitted with these safety devices after being put into operation. Another method, in more common use, is of the type shown in *Fig.* 6. This illustrates a two-hand control on a press in the Westinghouse plant. The ram cannot be started down until both of the hand levers are actuated. Left and right-hand push button controls sometimes are utilized for the same purpose.

Many other factors besides ease in operation, freedom from disease and protection from injury can be taken into consideration with advantage in design. Much depends on the type of machine. Elimination of vibration and noise, for instance, is receiving more attention, and with the increasing use of meters for measurement and classification the nerve-racking characteristics of some types of machines undoubtedly will be mitigated rapidly.

Sales of machinery in the design of which all of these factors have been given their due amount of consideration cannot fail to be higher than those on which they have been neglected. This will be particularly true in the new order through which we are passing. The designer has an added responsibility he will be glad to accept. In the fulfillment of it he will not only benefit the operator of his machines but will place in the hands of the sales department a much needed and effective selling asset.

Diesel Progress Leads To Wider Use

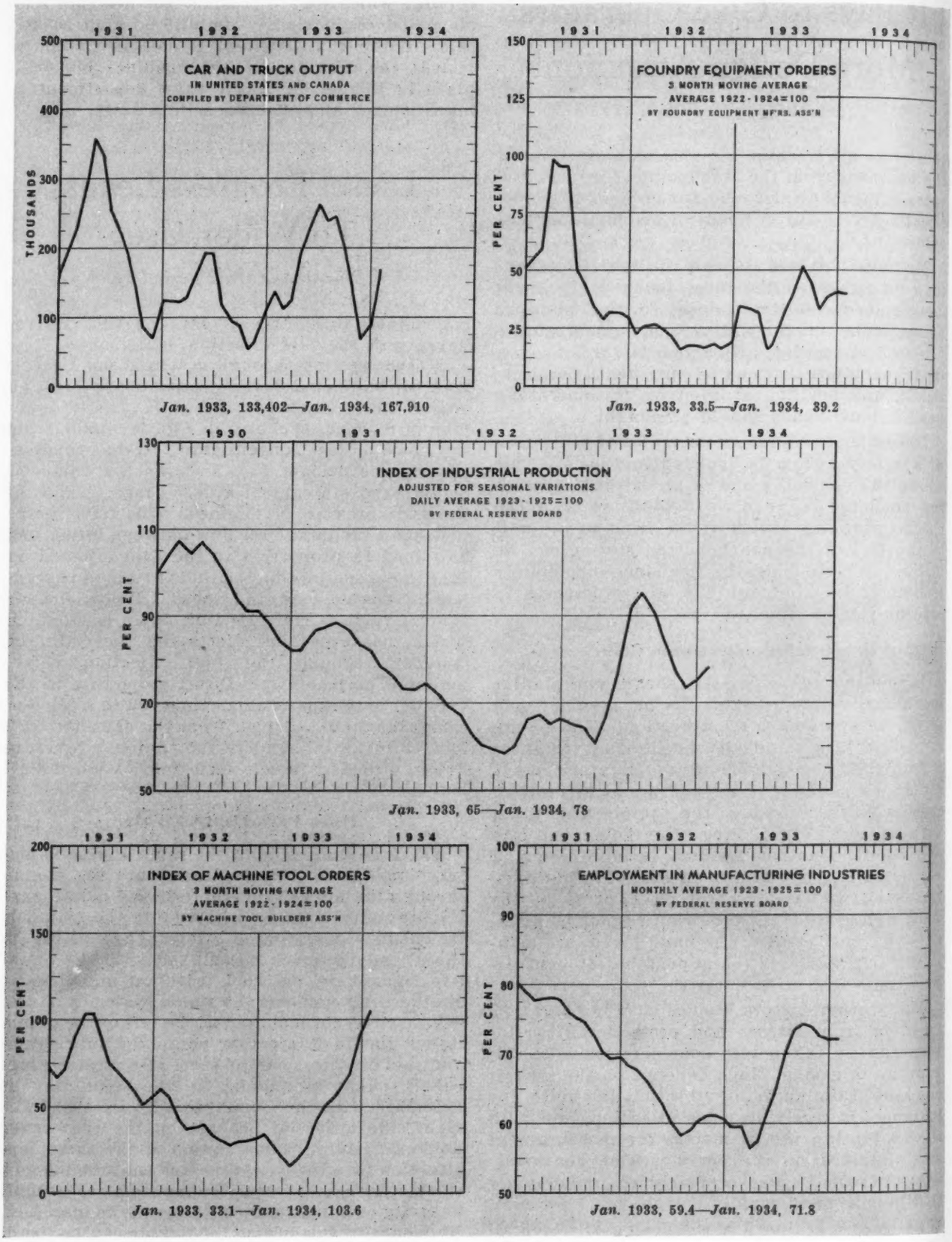
(*Concluded from Page* 35)

determines, to a large extent, the life and reliability of the fuel injection equipment.

A cross section through a Waukesha Hesselman oil engine, a fuel injection-spark ignition engine based on the patents of K. J. E. Hesselman of Sweden, is shown in *Fig.* 7. Aside from the more or less conventional internal combustion engine design, *Fig.* 5 shows the balanced piston type air control valve, characteristic of these low pressure oil engines. This valve serves to control the intake air flow between idling and half load in proportion to the fuel injected so that the proper air-fuel ratio is attained regardless of engine load and speed. Below the air control valve a fuel injection pump is mounted which measures and injects the fuel into the cylinder through the fuel injection valve, mounted horizontally. Directly opposite in the cylinder is the spark plug connected to a conventional magneto. Driven from the camshaft and located in the oil sump of the engine, a pressure pump provides forced feed lubrication to all bearings.

Must Pass Control Valve

The fuel pump side of the same engine is pictured in *Fig.* 6. Air is drawn into the engine through the air filter at the left and has to pass the air control valve on its way to the cylinder. By means of a system of levers, shown in *Fig.* 6, the air admission is interlinked with the quantity control on the fuel injection pump while another link connects the whole system with the engine governor mounted at the left of the pump. Below the fuel injection pump the lubrication and fuel oil filters can be seen, also a rotary fuel supply pump functioning in the same way as described with the Comet diesel. On the lower right side a special bracket on the rear cover holds a gasoline primer pump of the same construction as used on carburetor engines. A few strokes with this primer pump atomizes a small quantity of gasoline into the air intake manifold. By means of this device the engine can be hand-cranked with the same ease as a gasoline engine. As soon as firing starts, the governor operates the air and fuel controls and automatically shifts over to operation on fuel oil.



How Is Business?

SIMPLE ARITHMETIC

Yet Vital to Spring Performance

IN THE development of new equipment—efficient spring performance is not alone a matter of perfectly designed machines—or perfectly designed springs. Instead—it is a combination of both factors—of cooperation between the maker of springs and the manufacturer using them—that assures unfailing performance. In other words—1+1=2—the most valuable of all formulae when special or unusual installations are called for. If you are planning a new device—or if present spring applications are proving troublesome—we suggest that you get in touch with us. Interesting and detailed information is available.

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NOTEWORTHY PATENTS

BREAKING of eggs and separation of the contents from the shell is advanced from a tedious hand operation to an efficient machine method by a unit recently patented by Frank Piley for Borden's Produce Co. Inc., New York. In addition to eliminating unnecessary handling by the operator the machine permits inspection and prevent wastage of edible contents of the eggs. Space limitations restrict the use of illustrations to *Figs.* 1 and 2. Therefore many of the details of the mechanism will not be shown.

Eggs are delivered to the machine by a conveyor and drop into open cups such as 50 and 51, *Fig.* 1. Through a geneva movement the series of egg cups are advanced. During rotation the egg-carrying dial roller 71, *Fig.* 2, tracks in a groove of a cam drum (not shown). Gear segment 61 moves segment 60 on its pivot to bring cup 51 into alignment with cup 50,

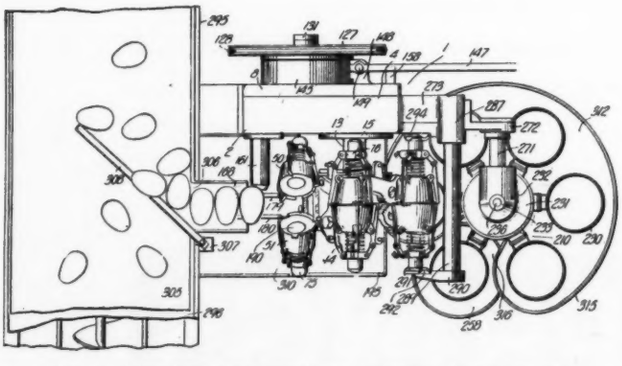


Fig. 1—Egg-breaking machine employs series of mechanical movements to separate contents from shell

thus enclosing the egg which is supported at its ends between concave disks 190. While this is taking place another pair of cups moves up to receive an egg from the delivery chute 168, *Fig.* 1.

During succeeding movement of the dial the semispherical ends 77, of the sleeves 75, *Fig.* 2, contact with inwardly curved portions of cam

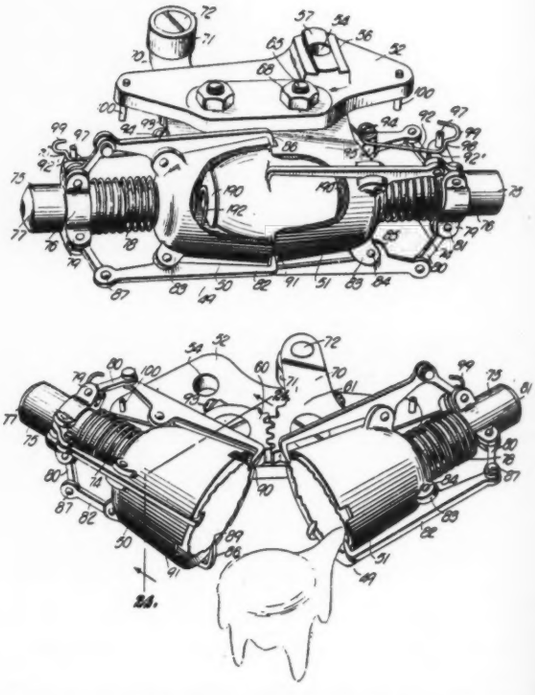


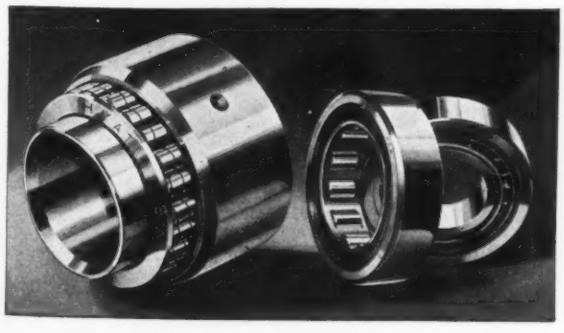
Fig. 2—Knife-fingers pierce the egg to divide the shell as the egg cups swing apart

plates (not shown), moving the sleeves inwardly on stub shafts 74 extending from the egg cups, and against tension spring 78. This movement of the sleeves causes links 80 to swing the rear ends of the knife-carrying fingers 82 outwardly, moving the fingers on their pivots 84. This projects the knife portions of the fingers through notches 91 of the cups to pierce the egg shell, whereupon latch portions 96 of springs 92 move into latching engagement with pins 97 on collar 76 so that the latch springs 92 retain the fingers in contact with the egg.

The geneva gear then advances the egg-carrying dial another step, during which interval the roller 71 has moved into an angular portion of a cam groove to cause gear segment 60 to move in an anticlockwise direction. This moves

(*Concluded on Page* 62)

WE HAVE BEEN AND ALWAYS HOPE TO BE "*Easy Prey*" FOR GAUGE SALESMEN



If you have any friends or relatives selling production precision instruments, send them to us. For, if they have something better than we use at present in testing our production, it's quite likely we'll want them.

It has become almost a "fetish" at the Hyatt factory to use every available aid for safeguarding quality—and we have gauges at almost every elbow, now—but if a few more will help us to manufacture longer life into Hyatts—we want them.

And that is why most users want Hyatt Roller Bearings. They know we leave nothing undone to assure them of a source of bearing supply in keeping with the excellence of their own product. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.

HYATT
ROLLER BEARINGS
PRODUCT OF GENERAL MOTORS

NEW MATERIALS AND PARTS

Erasing Machine Is Compact

AN ELECTRIC erasing machine, designed to be held in the fingers like a pencil, has been introduced by Charles Bruning Co., 102 Reade street, New York. This machine, shown herewith, is light and compact and the operator can maintain accurate finger control when erasing

Operator can erase ink or pencil lines rapidly with recently introduced electric erasing machine

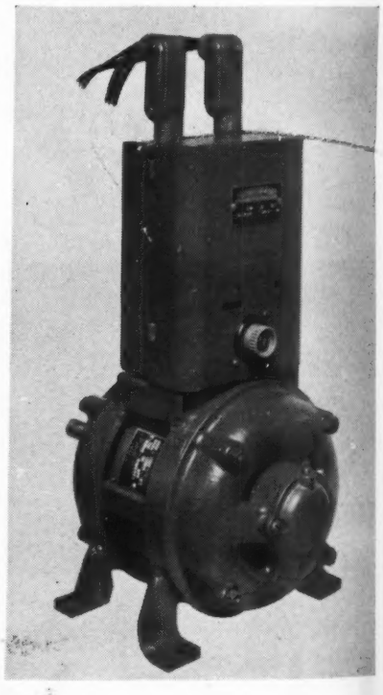
pen or pencil lines from tracings or drawings. The machine is operated by a self-contained electric motor which works on 110 volt circuits, both alternating and direct current. A complete assortment of pen and pencil erasers is furnished with the unit.

Introduces New Aluminum Finish

ALUMINUM finishes, deposited by an electrochemical process, which combine the beauty of Butler-finish silver with a hardness almost equal to that of natural abrasives have been introduced by Aluminum Goods Mfg. Co., Manitowoc, Wis. The process increases the depth of the ordinary aluminum oxide formation. At certain stages the finish is absorbent to dies, and brilliant solid color effects may be produced. The finish has been used on parts for food mixers, outboard motors, electric refrigerators, and similar machines.

Motors Are Self-Protected

MOTORS that are self-protected against burnout are a recent innovation of Lincoln Electric Co., Cleveland. This motor, shown herewith, has a protective device built into the windings. Should the motor be stalled through overloading, should it become excessively hot due to poor ventilation, should it run on single



Controls for alternating current induction motors are mounted on the motor. The controls protect the unit from accidental burn out

phase, or if for any other reason the motor is blocked the protector shuts off the current and the motor is saved from damage.

These alternating current induction motors are built in sizes from ½ to 30 horsepower, for either two or three phase and standard com-

Their continued ability to uphold the good name of motor-driven apparatus and machinery—often through the introductory period—has given Century Motors a good name with manufacturers and users all over the world . . . Century Engineers are always available for consultation and advisory service. • 1/250 to 600 horse power.

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1806 Pine Street St. Louis, Mo.
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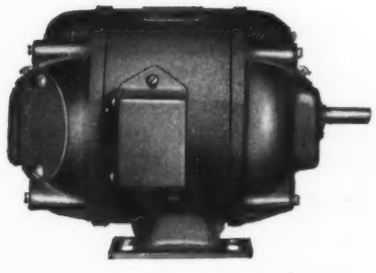


Century
MOTORS

MACHINES*

of all types are designed by Executives and Engineers who read Machine Design

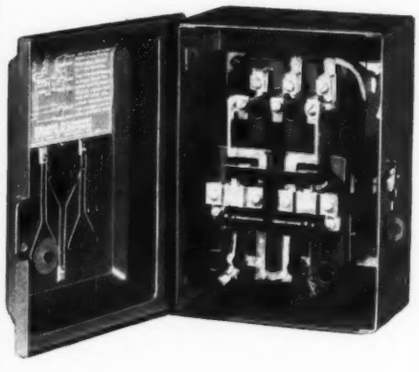
Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projector
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

mercial cycles and voltages. Controls are mounted on the motor. Where large motors are necessary to take care of only infrequent peak loads, a small size self-protected motor may be employed. At the high peak loads the protector will automatically disconnect the motor.

Solenoids Employed in Starters

A NEW solenoid type of automatic electric motor starter is being manufactured by Square D Co., Industrial Controller division, Milwaukee. The contactor, shown herewith, has a vertical, straight line, solenoid action and cannot be accidentally closed by vibration. Flexible leads have been eliminated. The thermal overload relays are mounted on the front of the panel and are easily interchangeable. Extra wiring space is provided in the cabinet and the push buttons are extra large—1-inch diameter. Contacts are silver, double break, and give high current rupturing capacity. The insulating base and arc barriers are porcelain, which does not carbonize nor readily collect dust.



Contacts of electric motor starter are silver, double break and give high rupturing capacity

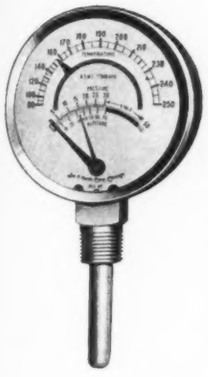
This starter is designated Class 8532 Type F and has maximum polyphase ratings of 5 horsepower, 220 volts; 7½ horsepower, 440-550 volts. It is also built with four-pole contactor for two-phase service

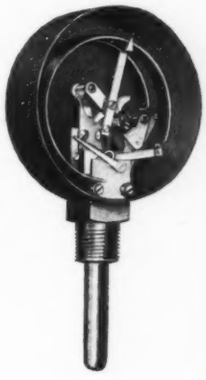
Instrument Gives Three Values

HOT water or low steam temperatures as well as pressures or feet of water can be read conveniently on the new Ther-Alti-Meter in the dial-type construction designed by Jas. P. Marsh Corp., 2073 Southport avenue, Chicago. The instrument in standard construction, shown herewith, is made with dial reading from 80 to 250 degrees Fahr., and with pressure reading from 0 to 30 pounds and with altitude reading from 0 to 70 feet height of water. An over-pressure feature prevents damage to the instrument should it be applied momentarily to more than the dial reading. It can be made up to special

order for other temperature and pressure ranges.

The instrument is constructed with two separate and independent sets of indicating mechanisms—one for indication of the temperatures, and the other for indication of the pressure or altitude. Both sets of indicating mechanisms operate on the bourdon tube principle. The connection socket is fitted with a temperature sensitive bulb which communicates with a bourdon tube assembly. Temperature changes of the fluid surrounding the bulb create varying internal pressures within the bulb, which, in turn, are communicated to the bourdon tube, expanding or contracting the latter. Movement of the bourdon tube is communicated to the indicating hand by means of an especially compensated noncorrosive movement mechanism. The connection socket also contains a pressure opening which communicates pressure or altitude changes to the other set of mechanism which functions on the conventional pressure gage principle.

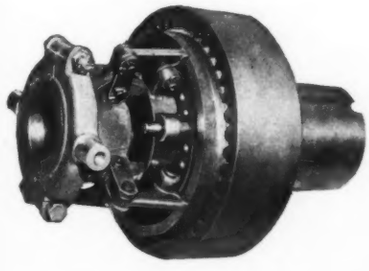




Dial-type meters will indicate hot water or low steam temperatures as well as pressures or feet of water

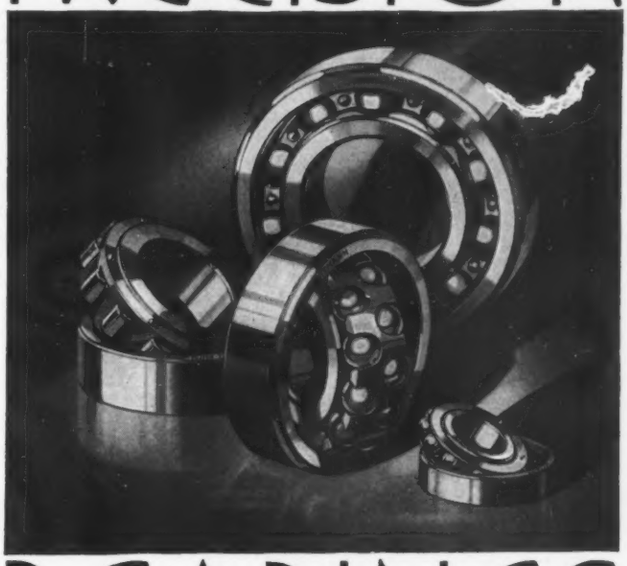
Introduces Improved Clutch Line

COMBINING the features of two lines of clutches into a single model, Twin Disc Clutch Co., 1328 Racine street, Racine, Wis., has introduced the B.F.T. series of clutches. These clutches, shown herewith, are available in capacities ranging from 3 to 80 horsepower per 100 revolutions per minute. The series comprises 8 sizes of clutches: 6½, 8, 10, 11½, 14, 16, 18 and 24 inches. The 6½ to the 14-inch sizes inclusive are made with 1, 2 or 3 plates; the 16,



New clutch unit combines the features of two previous clutch designs

PRECISION



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SILENT CHAIN DRIVES

. . . put power *on the job.* They can be depended upon to maintain constant speeds and to keep down operating costs.

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DETROIT
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SAN FRANCISCO
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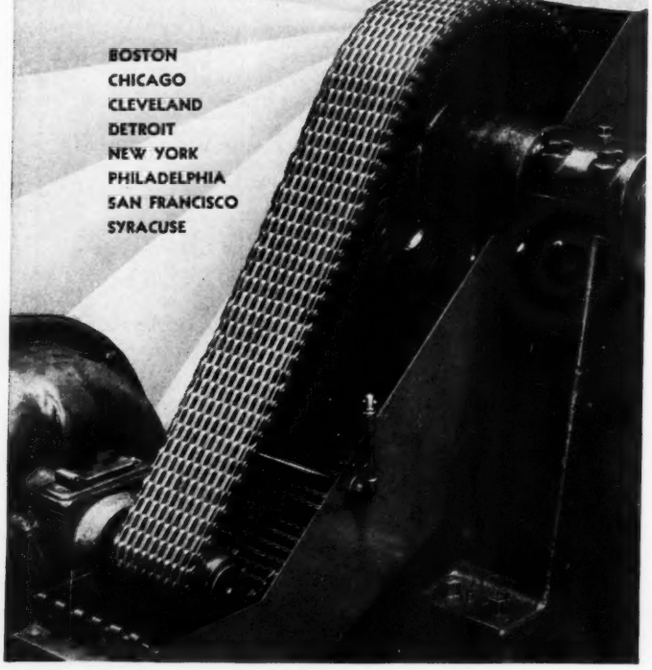
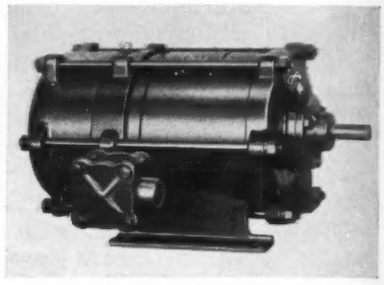


18 and 24-inch sizes are manufactured with 1 or 2 plates as required.

The company has also developed suitable driving spiders for use with all the sizes and for either 1, 2 or 3 plates as necessary. These spiders are available in three different styles for various installations and are of the internal gear tooth type. All clutches are of the toggle action type and, in addition to using gear tooth driving plates have inner plates, that take their drive from the hub, driven in the same manner.

Capacitor Motors Are Self-Contained

SINGLE phase, explosion proof capacitor motors which are self-contained are being manufactured by Louis Allis Co., Milwaukee. These motors, shown herewith, are especially adaptable for oil bulk station use as well as for use



Capacitor motors have positive-acting switch which cuts out the motor at a predetermined speed

in all Class I, Group D hazardous locations. A simple positive-acting switch cuts out the capacitor, built as an integral part of the motor, at a definite predetermined speed.

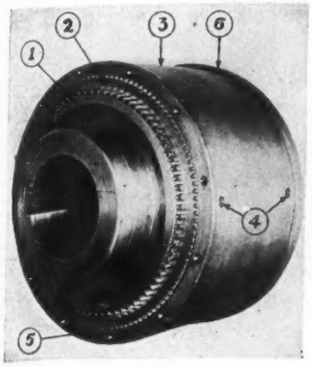
The new motor is available at present in the nonventilated type from ½ to 1 horsepower and totally enclosed fan-cooled type from 1½ to 3 horsepower. It is connectable externally for either 110 or 220 volts.

Geared Coupling Is Introduced

ALL steel, lubricated gear type couplings, known as Waldron Torque Ring couplings, are being offered by Smith & Serrell, 64-A Washington street Newark, N. J. Torque is carried in the coupling, shown herewith, by lubricated surfaces through solid metal parts from hub to hub. The end plates form the dust and moisture proof enclosure with the center sleeve to contain a supply of oil. Hubs are alike with toothed flanges at their centers.

The torque rings from which the coupling derives its name are two solid steel rings with teeth cut on the inside and outside. Thus is provided what is called quadruple engagement or four points at which relative movements between the co-operating teeth can take place and there-

by provide for misalignments or endwise displacement of the connected shafts. Torque rings are loosely held in place within the cover sleeve and they with the cover sleeve are handled as a single unit. Fifteen regular sizes for



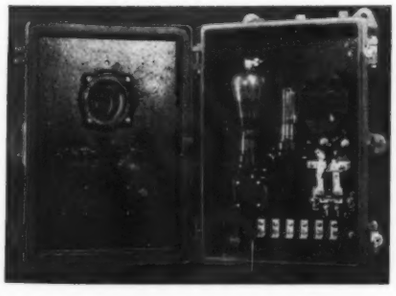
Torque ring couplings are made up of hubs (1), *torque ring gears* (2), *cover sleeve* (3) *and endpates* (6)

the couplings are listed for shafts from 1⅞ to 12 inches diameter with ratings from 22½ to 4840 horsepower per 100 revolutions per minute subject only to the occasional use of service factors on extremely high torque drives

---

Announces Improved Electronic Unit

ESPECIALLY adapted to industrial light-sensitive applications requiring operation on low light intensity, the RK Photo-Troller developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., operates on three foot candles with the phototube extended at distances up to ten feet. The unit, shown herewith, will operate on one-half footcandle when equipped with a pickup lens such as is available on certain



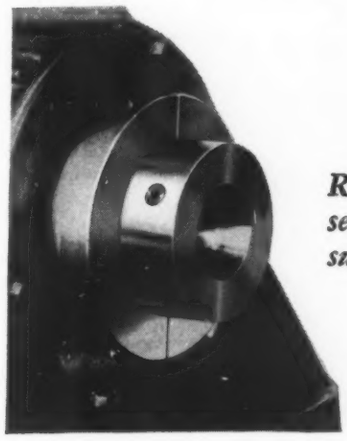
Electronic unit will operate with standard light sources up to a fifty-foot throw

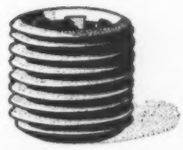
indoor and all outdoor models. The unit combined with standard light sources will cover up to a 50-foot throw. Invisible beams from standard light sources operate the RK units at 20 feet.

In operation the phototube operates the grid glow tube which in turn closes the contactor. No intermediate relays are required. Both tubes are of the industrial type, designed for this field of service. The contactor is provided with make and break contacts to obtain any operating sequence desired. Contacts will carry 20 amperes at 115 volts or 15 amperes at 220 volts

Try This...

on just one machine





Replace the ordinary set screws with quick, sure-setting BRISTOS

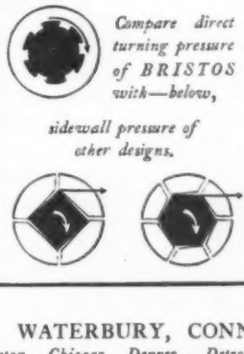
Let your operators decide whether BRISTOS save time and trouble

IN many plants you will find BRISTO Set Screws in general use on all kinds of equipment, as the result of a trial—such as we suggest to you. For a test experience with these unique Screws usually shows a worth-while saving in setting-time and labor.

BRISTOS speed up work. The wrench finds its own way into the fluted socket, without slipping or fumbling. Then, all the force needed for a tight set can be applied without fear of rounding out or splitting the BRISTO socket. The explanatory drawings show why.

Neater appearance, longer wear, protection against unauthorized tampering, are other advantages offered by BRISTO Set Screws and BRISTO Cap Screws. Many sizes are available . . . several under ¼ inch. Write for free samples. Try BRISTOS and see for yourself how these Screws . . . costing no more than ordinary screws . . . can simplify work and improve products.

WHY THEY'RE BETTER



Compare direct turning pressure of BRISTOS with—below,

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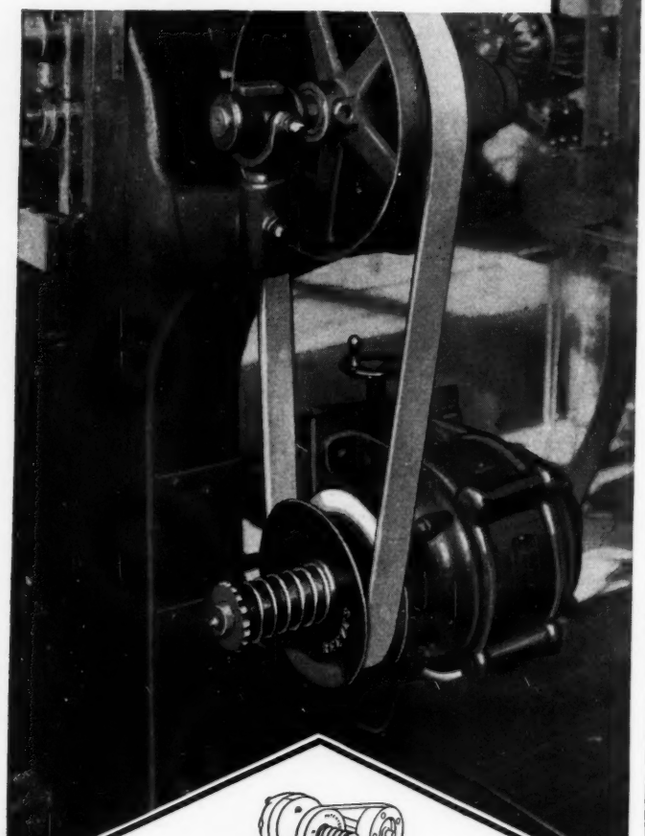
TRADE MARK

BRISTO

REG. U.S. PAT. OFF.

Hollow Safety **SET SCREWS** *Socket Head* **CAP SCREWS**

REEVES
Vari-Speed
MOTOR PULLEY



IN ITS field of application—fractional to 7½ H. P. drives, requiring not more than 3:1 ratio of speed—the REEVES Vari-Speed Motor Pulley assures *accurate speed selectivity* comparable only with the REEVES Variable Speed Transmission. Forming direct drive from motor to machine, it transmits power of any constant speed motor at any desired speed throughout its range of selectivity. Speed settings instantly obtained by means of convenient speed-control handwheel. Simple, compact, low in cost. Available in seven different sizes—each applicable to *standard* motor shaft extension. Used as standard equipment by many prominent machinery builders. Mail coupon for catalog.

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

Without obligation, send REEVES Vari-Speed Motor Pulley Catalog H-200. (3-34)

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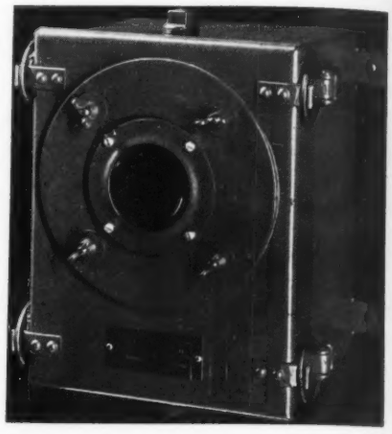
Address.....

alternating current. Speeds of operation as high as 300 per minute have been obtained.

The company has also brought out the Type E light source, shown herewith, for use with light-sensitive equipment. With this light source an intensity of 24 footcandles is obtained at 25 feet. The intensity varies inversely as the square of the distance for other distances. The light



Improved light source provides an intensity of twenty-four footcandles at twenty-five feet

source consists of an industrial source lamp rated at six volts, five amperes. Provisions are included for adjusting the focus of the lens with respect to the lamp so as to locate the beam at the desired spot. A transformer is included so that the lamp can be operated from any commercial source of power except direct current. An infra red filter to provide an invisible light beam is an optional accessory.

Conduit Is Explosion Proof

WATERTIGHT, vaportight and explosion proof conduit fittings that are flexible, known as Pyle-O-Flex, have been developed by Pyle-National Co., 1334 North Kostner avenue, Chicago. The fittings, shown herewith, meet the demand for an explosion proof and watertight conduit fitting having the mechanical features

Conduit is adapted to the safe wiring of machines installed in hazardous locations

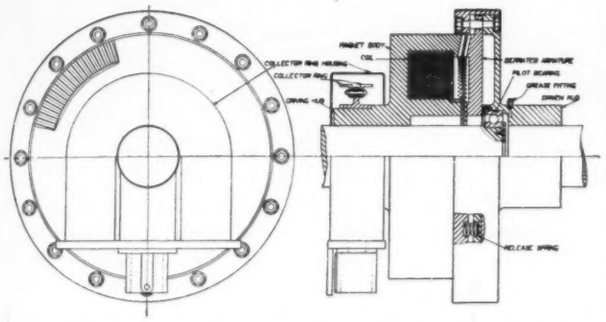
of standard flexible conduit in ease of application. They are adapted to the safe wiring of machines used in gasoline stations, refineries, grain elevators and other places where dust creates hazardous conditions requiring the explosion proof installation of electrical equipment, and to machinery used on ships, docks, and other exposed locations. Brewery, distillery, chemical

plant and dry cleaning plant machinery offer advantageous fields for use.

The conduit withstands vibration and is said to be capable of withstanding 500 pounds hydrostatic pressure. It is listed by the underwriters' Laboratories for use in Class I, Group D, and Class II, Group G hazardous locations.

Clutch Gives Positive Engagement

TO MEET the demand for clutch unit of quick and positive mechanical engagement, Dings Magnetic Separator Co., Milwaukee, has brought out a magnetic clutch-coupling. The contact surfaces of the unit, shown herewith, are of serrated V-tooth character to insure positive engagement when the magnet coil is energized.



Quick and positive mechanical engagement is provided by improved magnetic clutch-coupling

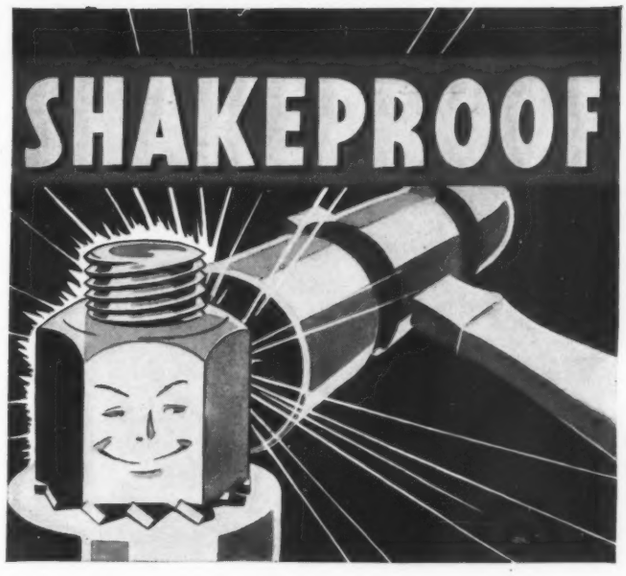
These serrations are of 3-degree angle pitch and of equal depth over the whole contact face. Faces of the magnet and the floating armature are parallel and at an angle to the shaft.

The clutch-coupling permits of ready separation and the removal of one shaft without disturbing the shaft mounting of the companion element. Following the usual practice, the magnet coil is form wound and vacuum pressure impregnated. The slip rings and brush holders are protected by dustproof housings.

Pulley Provides Variable Speeds

DESIGNED for operation at motor speeds, the new variable speed pulley added to the line of Winfield H. Smith Inc., Springville, Erie Co., N. Y., consists of two conical sections or half pulleys. These half pulleys have slots on their conical faces permitting them to interlock. Each half pulley is mounted on a bushing having a spiral key which engages with a spiral groove in the bore of the pulley. The bushing is keyed or setscrewed to the motor shaft.

As the base of the motor is moved back and forth, the two half pulleys will move together, or will separate, causing the belt to run on a



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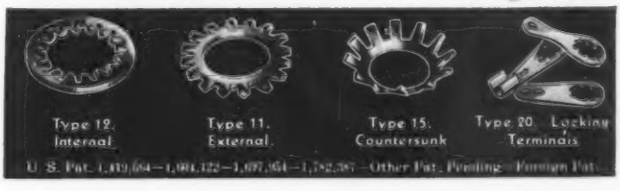
Type 12. Internal.
Type 11. External.
Type 15. Countersunk
Type 20. Locking Terminals
U. S. Pat. 1,419,664—1,601,122—1,697,564—1,792,367—Other Pat. Pending—Foreign Pat.

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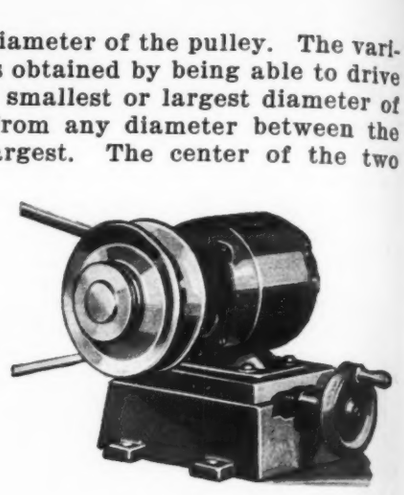
small or large diameter of the pulley. The variation in speed is obtained by being able to drive from either the smallest or largest diameter of the pulley, or from any diameter between the smallest and largest. The center of the two



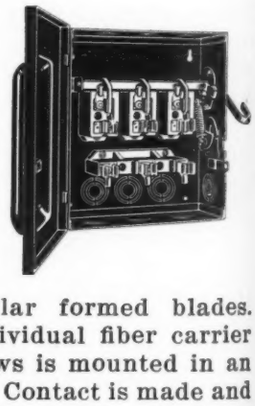
Variation in speed with motor pulley is obtained by varying the effective diameter of the pulley

half pulleys is always in line with the center of the driven pulley which permits the use of a standard V-belt and of a standard V-belt pulley for the driven pulley

---

Controls Have New Switch Mechanism

COVER control, quick make and quick break, fused and unfused industrial switches in a new line have been announced by Wadsworth Electric Mfg. Co. Inc., Covington, Ky. The switches, shown herewith, are available in 2, 3, 4 and 5 poles, 230 and 575 volts. They come equipped with a new switch mechanism which



New switch mechanism has self-aligning rectangular formed blades

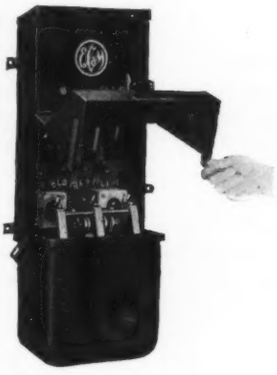
has self-aligning rectangular formed blades. Each blade seats in an individual fiber carrier while each set of switch jaws is mounted in an individual insulated recess. Contact is made and broken within the insulated recess. Positive quick acting make and break mechanism and a positive interlocking device are part of the switch. The cabinet is small, yet it has ample working space.

Starters Are Operated Magnetically

ACROSS-THE-LINE combination magnetic starters for motors up to 30 horsepower, 220 volts, 60 horsepower, 440 volts, and 75 horsepower, 550 volts have been announced by Electric Controller & Mfg. Co., 2708 East Seven-

ty-ninth street, Cleveland. This starter, known as No. 2 Type ZOS and shown herewith, is a larger companion for the No. 1 Type ZOS starter announced recently. It contains an unfused or fusible safety switch and a magnetic starter with overload relays. All of the internal wiring of the starter is complete. Its small size makes it especially desirable for mounting on motor driven machines.

Heavy duty construction is used throughout. Safety switches have wiping wedge, double-break contacts and heavy gage steel parts with all actuating parts casehardened. Magnetic starters have bushed arm bearings, large clearances between live parts and high arc rupturing capacity. Overload relays are designed to provide sensitive overload protection.

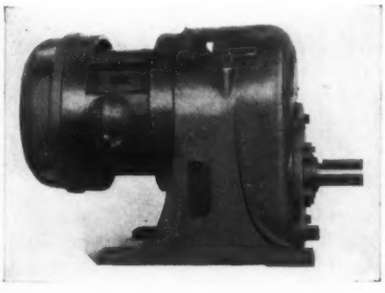


Combination magnetic starter contains an unfused or fusible safety switch and a magnetic starter with overload relays

Gearmotors Use Single Reduction

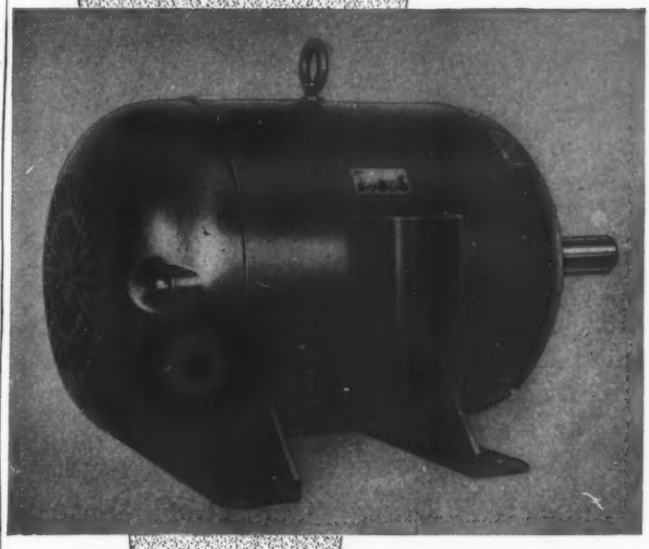
SINGLE reduction units intended for use for ratios up to 6:1 have been added to the line of gearmotors manufactured by Reliance Electric & Engineering Co., 1048 Ivanhoe Road, Cleveland. The units, shown herewith, can be furnished with both alternating and direct current motors of various types in sizes rated ¾ horsepower and higher. Multispeed and adjustable speed motors may be used.

The entire reduction is obtained in a single pair of gears. Feet, cast integral with the gear housing, afford a solid support close to the point of maximum torque application. Antifriction bearings are used throughout.

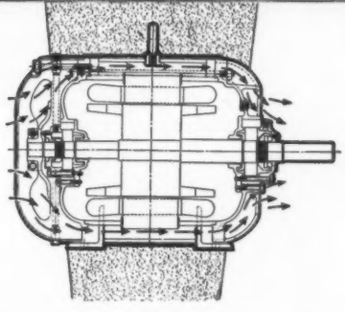


Motorized reduction units can be furnished with either alternating or direct current motors in a variety of types

Totally-Enclosed Fan-Cooled Motors



Type CP



Motors that won't stay on the job without requiring extra maintenance and protection have no business operating in atmospheres laden with dust, filings, fumes, moisture, etc. . . . The ordinary open type motor is all right in its place, but where destructive agencies are present in sufficient quantity to cause motor shutdowns and shorten the life of motors, Wagner totally-enclosed fan-cooled (Type CP) motors should be used. As the accompanying sketch shows, these motors are specially built to operate under such conditions. The motor proper is housed in a frame which has no openings. Moisture cannot come in contact with the rotor and the stator. . . . These motors are especially desirable for machinery that must continue in operation, as their use prevents frequent shutdowns for cleaning, repairing and replacement. . . . To eliminate avoidable shutdowns of motors, use Wagner totally-enclosed fan-cooled motors. For complete description, ask for Bulletin No. 174-5B.

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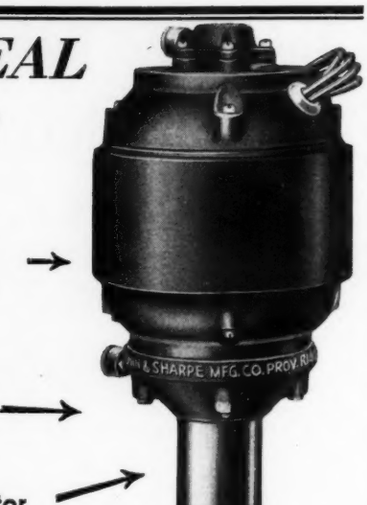

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ALLOYS (STEEL)—The use of manganese steel castings in a number of industries and the advantages of their use are covered in a recent issue of *The Amsco Bulletin*, published by American Manganese Steel Co., Chicago Heights,. Ill.

ALUMINUM—Aluminum Co. of America, Pittsburgh, is distributing the first issue of its *Aluminum News-Letter* which is designed to acquaint those interested in business and industry with the most recent developments in the aluminum industry

BEARINGS—Ball and roller bearing pillow blocks are presented in bulletin No. 943-A of Norma-Hoffman Bearings Corp., Stamford, Conn. A complete range of 2-bolt and 4-bolt pillow blocks, with bearings, is discussed, together with several series of take-up mountings, machine mountings and flange mountings adapted for various machine assemblies. Shaft sizes range, in the several types, from $\frac{11}{16}$ to 8-inch diameter. Load ratings and mounting instructions supplement the specification data.

BEARINGS—New bearing types, new list prices and additional sizes of existing types are included in the recently issued Ninth edition of the ball bearing catalog published by New Departure Mfg. Co., Bristol, Conn. The booklet also contains information on bearing design and load characteristics; typical mounting designs; factors for the selection of bearings at electric motor speeds; factors for selecting bearings for speeds down to 10 revolutions per minute; and fits and weights for all bearings

COUPLINGS—Smith & Serrell, Newark, N. J., is distributing bulletin No. 48 on its line of Waldron torque ring couplings, all steel, lubricated gear type couplings employing the newly patented principle of quadruple engagement. The bulletin describes and illustrates the couplings and gives sizes and dimensions.

DRIVES—Single-reduction gearmotors, Type S, for alternating and direct current applications are described in bulletin 402 of Reliance Electric & Engineering Co., Cleveland.

DRIVES—Power units which combine a helical gear transmission and a motor of any make or characteristics to deliver power at the required speed are described in a folder of J. D. Christian Engineers, San Francisco.

DRIVES—Roller chains and sprockets are covered in a most complete booklet, V-115, prepared by Whitney Mfg. Co., Hartford, Conn. The booklet gives advantages of the roller chain drive; lubrication information; data on design of roller chain drives, their selection, chain lengths and similar engineering information; includes application photographs; and describes the chains and their parts completely giving tables of dimensions for all sizes.

FASTENINGS—Parker-Kalon Corp., New York, has

prepared a 36-page catalog giving complete information and technical data relating to the use of the company's various types of self-tapping screws and nails. For each of the parts the data book gives a description, specifications, application illustrations, and information on their benefit to the design. The fastenings covered include hardened self-tapping sheet metal screws; hardened self-tapping cap screws with hex head; self-tapping sheet metal screws made of corrosion resisting materials; metallic drive screws; wing nuts; and similar devices.

INSTRUMENTS—Equipment for making photoelastic studies and methods of making the tests are described in a recent issue of *Cenco News Chats* published by Central Scientific Co., Chicago. With this equipment the value of the strain picture produced is instantly apparent and by a few changes in design the strains may be distributed to cover a wide area, thereby increasing the strength and life of the part.

MOTORS—Louis Allis Co., Milwaukee, is distributing bulletin No. 505-C which shows the detailed construction of motors manufactured by the company and completely illustrates and describes the characteristics and uses of a number of different types of motors.

MOTORS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is distributing catalog inserts on explosion resisting fan cooled motors, and on its new line of fractional horsepower motors including Type FR repulsion-start induction, Type FK direct current and Type FS polyphase squirrel-cage.

PUMPS—Cycloidal rotary pumps are described in bulletin 60-B10 of Roots-Connersville Blower Corp., Connersville, Ind. These pumps are built on the two-impeller principle, with two and three-lobe impellers, depending upon the type of service to which they are applied.

SHEAVES—Allis-Chalmers Mfg. Co., Milwaukee, has prepared a revised leaflet, No. 2134-A giving engineering data such as sheave diameters, number of grooves, bores and other dimensions on Texsteel sheaves for Texrope drives.

Research Publications

Revised Report of National Screw Thread Commission. Progress in screw thread practice between 1928 and 1933 made necessary several revisions and some additions to the standards set forth in the 1928 report. These changes include: The addition of five sizes to the coarse and one to the fine thread series; the elimination of all sizes above 1½ inches from the fine thread series; the elimination of the small machine screw sizes from class 4, close fit; the addition to four sizes to the hose-coupling threads; and the revision of the specification for Acme threads. The fine series is supplemented by a new 8-pitch, a revised 12-pitch, and a new 16-pitch thread series. The present publication is the final report of the commission, representing the culmination of 15 years work. Published as MP No. 141 by bureau of standards. Available from Superintendent of Documents, Government Printing office, Washington. 15 cents.

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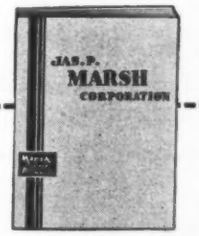

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Noteworthy Patents

(*Concluded from Page* 48)

gear segment 61 in a reverse direction carrying the cups into open position as shown in *Fig.* 2. because the fingers are projecting through the egg shell, opening of the cups of course divides it in half. In this position the cups have traveled approximately 180 degrees through their cycle and now are directed outwardly, discharging the contents of the egg into an inspection cup 230, *Fig.* 1. The egg inspection turret is advanced simultaneously with the egg-carrying dial, movement being synchronized through gearing.

Continued motion of the geneva mechanism brings the egg cups to rest in front of air nozzles (not shown) where blasts of air are directed into the upper portions of the shells to dislodge and remove any of the whites that may adhere to them.

Number of the patent is 1,945,788.

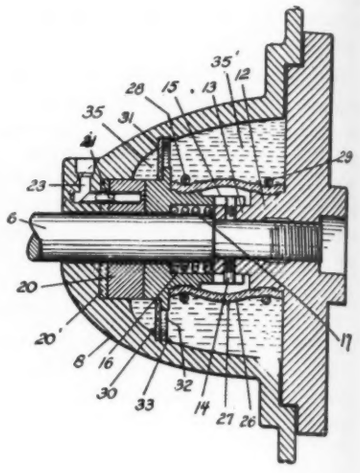
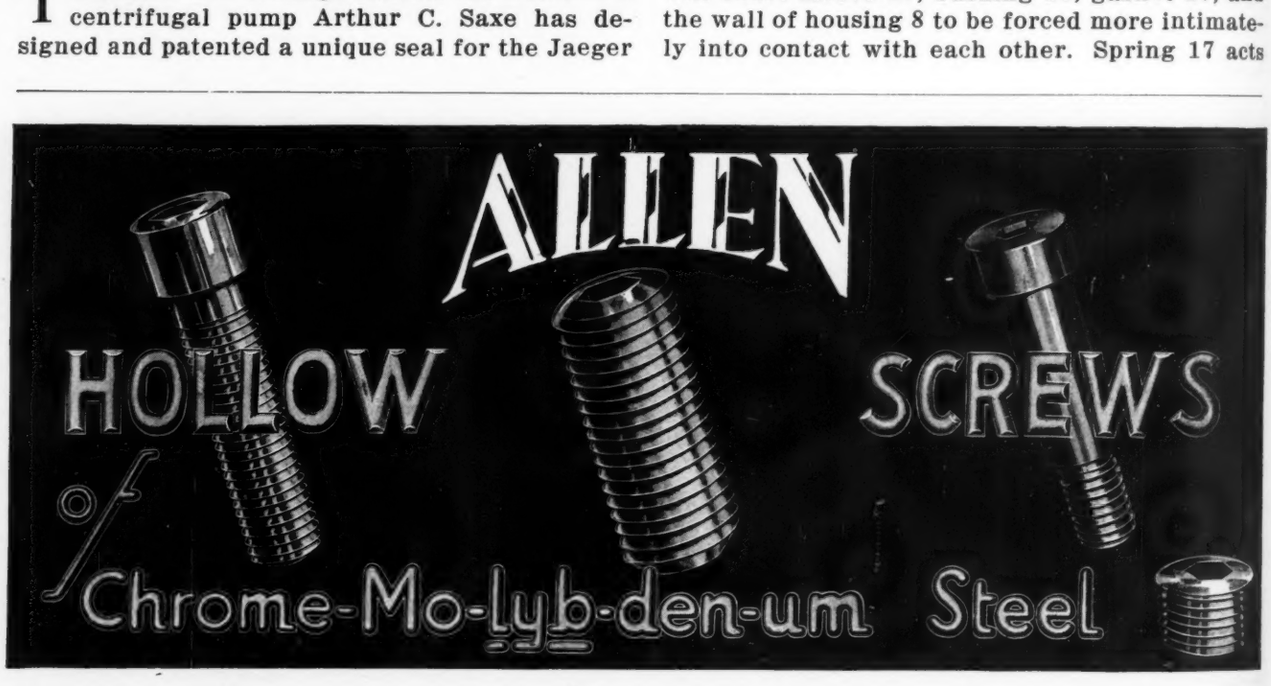


Fig. 3—Shaft seal prevents leakage by employment of a rubber sleeve and spring which counteract the effects of either suction force or back pressure in pump

TO PREVENT leakage around the shaft of a centrifugal pump Arthur C. Saxe has designed and patented a unique seal for the Jaeger Machine Co., Columbus, O. When a pump employed to deliver water to a comparatively high level there obviously will be considerable back pressure set up in the housing. At 8, *Fig.* 3, which shows a section through the new pump, the back pressure exerted on a bulge in a rubber sleeve 26 tends to elongate it. This in turn will cause sleeve 15, bushing 20, gasket 20, and the wall of housing 8 to be forced more intimately into contact with each other. Spring 17 acts



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to keep these parts together. Rubber sleeve 26, held by wires 28 and 29 on sleeve 15 and portion 12 of the hub, also aids in precluding the entrance of air into housing 8 and in preventing leakage of water around the shaft.

Sleeve 15 rotates with shaft 6, while housing 20 remains stationary, so that most of the wear is between these surfaces. Lubricant between the surfaces aids in obviating leakage. Rotation of sleeve 15 will set up centrifugal force and tend to throw away any sand or dirt particles from the joint between the end of this sleeve and the bushing. Any suction force which usually is set up in the housing 8 when the unit is being used for pumping water to a comparatively low level, tending to pull the various parts of the seal apart, will be offset by the force of spring 17.

The patent is designated No. 1,945,825.

BY KNURLING portions of the axle and grooving the bores of inner bearing cones a positive lock against rotation of the bearing on the shaft is provided in a newly patented conveyor roller. The designer is Charles A. Adams, with the Mathews Conveyor Co., Ellwood City, Pa. as assignee of the patent designated No. 1,-

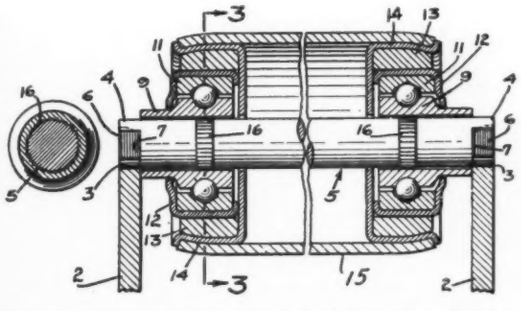

Fig. 4—Knurled surfaces coincide with internal grooves, thereby locking inner bearing on shaft

943,998. As shown in *Fig.* 4, shaft 5 is knurled at 16; longitudinal grooves are provided in bearing cones 9. Thus a gear lock arrangement is effected. Flattened faces 6 constitute means for locking the axle against movement during the operation of the conveyor. Outer bearing cone 11 is secured in housing 12 mounted within annular member 13, fitted in cup-shaped member 14 which is secured in the end of roller 15.

The means of locking the inner race on the shaft facilitates adjustment, inasmuch as the grooved race can be removed readily from the knurled portion of the shaft. When the upper portion of the bearing groove becomes worn from continually carrying the load, the inner bearing can be turned to present a new wearing surface to the load.

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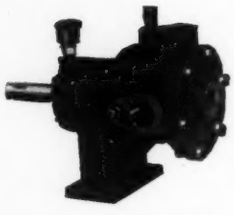

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MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

Business and Sales Briefs

J. A. DOUCETT, formerly vice president and general sales manager of Revere Copper & Brass Inc., New York, has been appointed vice president in charge of sales. C. A. Macfie, formerly assistant sales manager of the company, has been made general sales manager. Both Mr. Doucett and Mr. Macfie will be located at the Revere executive offices at 230 Park avenue, New York.

* * *

J. L. Van Nort is now representing Reliance Electric & Engineering Co., Cleveland, as sales engineer with the Chicago office. Previously, Mr. Van Nort has represented the Reliance company in the New England and Cincinnati districts.

* * *

J. G. Bell has been appointed alloy steel sales representative for Youngstown Sheet & Tube Co., Youngstown, O., with headquarters at Cleveland.

* * *

S. H. Worrell, formerly associated with Detroit Seamless Steel Tubes Co., is now affiliated with the Detroit office of Pittsburgh Steel Co., Pittsburgh, in the sale of steel tubing and mechanical tubing.

* * *

Harold B. Ressler, vice president in charge of sales of Joseph T. Ryerson & Son Inc., at Chicago, has been transferred to the Jersey City plant of the company where he will be in charge. Mr. Ressler will maintain a close contact with the other eastern Ryerson plants at Buffalo, Philadelphia and Boston.

* * *

W. B. Arbuckle, with offices located at 1006 Washington avenue, Houston, Tex., has been appointed as district representative for Allen-Bradley Co., Milwaukee. Mr. Arbuckle will handle the company's complete line of control apparatus including manual and automatic, alternating and direct current motor starters, rheostats, relays and auxiliaries.

WANTED
A NEW PRODUCT

A company experienced in marketing improved methods in the process industries involving the use of patented machinery or processes is anxious to acquire additional products. It has ten sales offices in this country and three in foreign countries. It has a staff of twenty or more graduate mechanical and chemical engineers with well equipped laboratories and a factory equipped to manufacture the most accurate precision machinery. If you have a product, preferably one selling for $1000 or more per unit, now ready to market, this company has the equipment, the organization, the capital and the experience to manufacture the product and to develop the market in the shortest time.

Replies, addressed to Box 103, c/o Machine Design, Penton Building, Cleveland, will be held confidential.

CULLMAN
SPEED REDUCER

IS YOUR SPEED REDUCER SPACE LIMITED?

The Cullman Speed Reducer can be used where lack of space would not permit the use of other equipment.

The compactness of the Cullman reducer is due to the flexible chain and sprocket drive, which as the first reduction, cuts the first gear contact speed from two to six times the motor speed.

Low point of gear contact makes possible an oil level that submerges the gearing, while the moving chain throws a spray of oil over all the bearings.

Motor mounted on adjustable base . . . no dangerous moving parts . . . oil and dust proof.

Made in sizes from 1/8 to 15 H.P.; single, double and quadruple reduction types.

Send for booklet giving complete information as to types, sizes and speeds.

CULLMAN WHEEL CO., 1356 Altgeldt St., CHICAGO, ILL.
Send me the Cullman Speed Reducer booklet.

Name.....

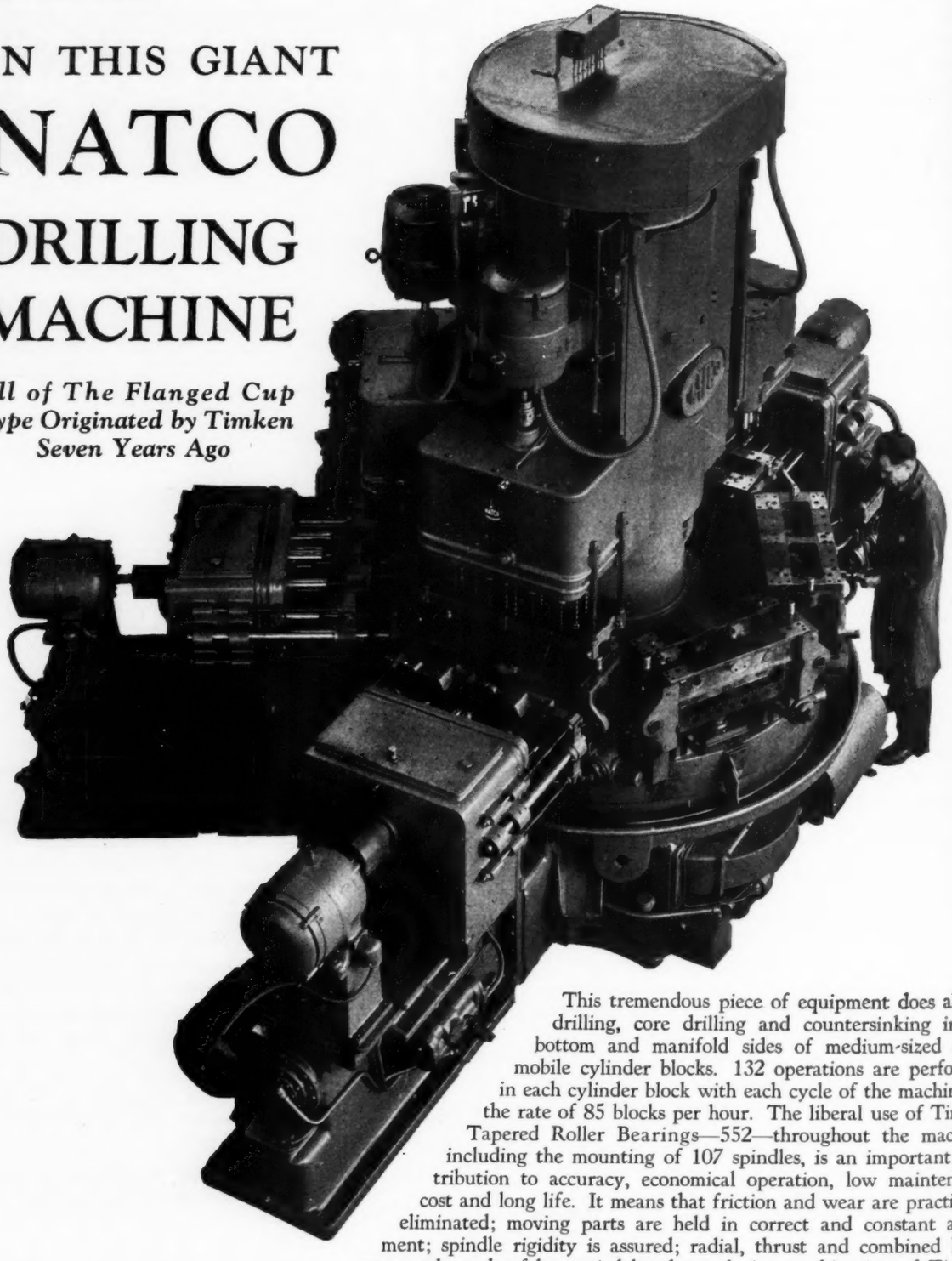
Company.....

Address.....

552 TIMKEN BEARINGS

IN THIS GIANT NATCO DRILLING MACHINE

All of The Flanged Cup Type Originated by Timken Seven Years Ago



This tremendous piece of equipment does all the drilling, core drilling and countersinking in the bottom and manifold sides of medium-sized automobile cylinder blocks. 132 operations are performed in each cylinder block with each cycle of the machine, at the rate of 85 blocks per hour. The liberal use of Timken Tapered Roller Bearings—552—throughout the machine, including the mounting of 107 spindles, is an important contribution to accuracy, economical operation, low maintenance cost and long life. It means that friction and wear are practically eliminated; moving parts are held in correct and constant alignment; spindle rigidity is assured; radial, thrust and combined loads are surely and safely carried by the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken alloy steel.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**